COMMENT

Why Money Talks and Wealth Whispers: Monetary Uncertainty and Mystique

A Comment by Roel M.W.J. Beetsma and Henrik Jensen

We demonstrate that in important cases Propositions 3 and 4 in Eijffinger, Hoeberichts, and Schaling (*Journal of Money, Credit, and Banking*, May 2000) may fail. Moreover, their monetary policy delegation arrangement, which advocates that central banker preference uncertainty may be desirable, is dominated by other arrangements without any such uncertainty. Finally, their way of modelling preference uncertainty leads to arbitrary effects on average monetary policy. Without these, preference uncertainty is never desirable.

In a recent article in this journal, Eijffinger, Hoeberichts, and Schaling (2000), henceforth EHS, argue that monetary policy uncertainty may be welfare enhancing. More specifically, uncertainty about the weight that the central bank attaches to inflation stabilization helps to reduce output variability, as the central bank on average reacts more vigorously to supply shocks. This gain may dominate the losses associated with weight uncertainty in their setup, which take the form of a higher inflation variability, and—if a Barro and Gordon (1983) type of credibility problem prevails—a higher inflation bias. Taking central bank preference uncertainty as a proxy for central bank secrecy, this result leads EHS to conclude that their paper "explains why high credibility institutions such as the former Bundesbank *can afford* to be relatively closed, and why low credibility institutions such as the Reserve Bank of New Zealand and the Bank of England *need* to be very open …" (p. 231).

This paper comments on EHS. Firstly, we show that *precisely* when the central bank has high credibility, uncertainty about its preferences may actually be *un*desirable. This implies that EHS' central Proposition 4 may fail and, hence, that their claim that "high credibility institutions … *can afford* to be relatively closed" is

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unwarranted. The main reason for this potential failure is that EHS' Proposition 3, which states that output variability is always minimized for a positive level of preference uncertainty, may also fail.

Secondly, we argue that the role for preference uncertainty is generally much weaker than EHS claim. In their setup, preference uncertainty can be beneficial if monetary policy is delegated to a central bank with a suboptimal degree of conservatism (in the sense of Rogoff 1985), which causes inefficiently high output variability. Introducing uncertainty about the preferences of this central bank may help to correct this inefficiency because it may induce the bank to act in a more "liberal" way on average. However, imposing the appropriate inflation contract (Walsh 1995) or the appropriate inflation target (Svensson 1997) takes the economy right to the socially optimal equilibrium, thereby obviating the need for preference uncertainty. Even if these arrangements are not feasible, one might do better by choosing the optimal degree of conservatism right away. This is confirmed by numerical results for a wide range of parameter combinations.

Lastly, we demonstrate that the particular direction in which preference uncertainty in EHS affects the central bank's average responses to, for example, supply shocks is arbitrary. We do this by illustrating that if uncertainty is modeled in just a slightly different (but analogous) manner, its effects on average monetary policy responses are exactly the opposite of those obtained by EHS. In order to isolate the implications of preference uncertainty on policy uncertainty, we therefore examine a preference specification adopted from Beetsma and Jensen (1998), from which the average effects of preference uncertainty are absent. With this specification, central bank preference uncertainty is unambiguously harmful for society. Hence, if one concurs with EHS that preference uncertainty is a proxy for secrecy in monetary policymaking, then one must be very careful in advocating such secrecy.

1. THE EHS MODEL

We briefly present the EHS model using their notation. Output is given by a reduced-form Lucas supply function:

$$y = y^* + b(\pi - \pi^e) + \varepsilon, \quad b > 0, \tag{1}$$

where y is the (log of) output, $y^* > 0$ is the natural level of output, π is inflation, π^e is expected inflation, and ε is a white noise shock with zero mean and variance σ_ε^2. Society's loss function is

$$S = \alpha\pi^2 + (y - ky^*)^2, \quad 0 \leq \alpha < \infty, \tag{2}$$

where desired output exceeds the natural level if $k > 1$. This implies the familiar inflation bias under discretionary monetary policy (cf. Barro and Gordon 1983).

Monetary policy is delegated to a central bank with the loss function:

$$L = a_t\pi^2 + (y - ky^*)^2, \quad 0 \leq a_t < \infty \,, \tag{3}$$

where

$$a_t = \bar{a} - x_t, \text{ with } \mathrm{Var}[x_t] = \sigma_x^2 \text{ and } \mathrm{E}_{t-1}[x_t] = 0 \,. \tag{4}$$

Hence, x_t represents a shock to the weight the central bank attaches to inflation stabilization, and σ_x^2 is consequently adopted by EHS as a measure of preference uncertainty. EHS assume that $\mathrm{E}_{t-1}[\varepsilon x_t] = 0$. Actually, they make the implicit assumption that ε and x_t are statistically independent, as this prevents functions of ε and x_t from being correlated. We maintain this independence assumption in what follows.

The timing within the period is as follows. First, π^e is determined (for example, via agreements on nominal wage contracts) by the private sector under the assumption that they form expectations rationally. Second, x_t materializes (by assumption always implying a positive a_t), followed by the realization of ε. Then, the central bank decides on monetary policy by choosing π. Finally, output is determined.

With this setup the central bank's reaction function is

$$\pi = \left[\frac{b}{\bar{a} - x_t + b^2}\right](b\pi^e + z - \varepsilon) \,, \tag{5}$$

where $z \equiv (k - 1)y^* > 0$. Because the inflation bias is increasing in z and disappears when $z \to 0$, z can be seen as a proxy for the amount of credibility problems. The right-hand side of Equation (5) is a nonlinear function of the preference shock. To solve the model, EHS employ second-order Taylor approximations of ratios of stochastic variables. However, these approximations are too crude and, therefore, become the main source of the mistakes in EHS' results. We show this in Appendix A (available upon request). Nevertheless, in the following our arguments are made without resorting to approximations.

2. THE POTENTIAL FAILURE OF EHS' PROPOSITIONS 3 AND 4

EHS' Proposition 3 says that if credibility problems (measured by z) are not too large, then the variance of output is minimized for a positive level of central bank preference uncertainty, σ_x^2. This result is used as a step toward their Proposition 4, which states that if credibility problems are sufficiently small, then society's expected loss attains a minimum for a positive level of preference uncertainty. In this section we show that *precisely* when credibility problems are minimal, EHS' Propositions 3 and 4 may fail.

Throughout this section, let $z = 0$. Hence, credibility problems are absent. By the continuity of all the functions involved, the ensuing results also hold when

$z > 0$, but sufficiently small. Because x_t and ε are statistically independent, $\pi^e = 0$ and $y = y^* + [a_t/(a_t + b^2)]\varepsilon$. Hence,

$$\mathrm{Var}[y] = \mathrm{E}\left[\left(\frac{\bar{a} - x_t}{\bar{a} - x_t + b^2}\right)^2\right]\sigma_\varepsilon^2 . \tag{6}$$

The term in square brackets can be concave in x_t, convex or both, depending on the specific value of x_t. By Jensen's inequality, when it is strictly convex, Var[y] is minimized for $\sigma_x^2 = 0$, so that Proposition 3 in EHS fails in this case. An example is when $x_t > -\bar{a}$ with probability one. A sufficient condition for strict convexity then is that $4\bar{a} < b^2$ (see Appendix B; available upon request). The intuition for why the proposition may fail is the following. Although more preference uncertainty induces the central bank to respond stronger to supply shocks on average (because the term in square brackets in Equation 5 is strictly convex in x_t), there is also more uncertainty in its response. As a result, the overall effect on the variance of output is ambiguous.[1]

Now, consider the case of $\bar{a} = \alpha$. This is an important case, because in the absence of preference uncertainty, the central bank's loss function now coincides with society's loss function. Given that all distortions are absent, this yields the *first best* equilibrium and, hence, the minimum attainable expected loss for society. It then follows immediately that introducing preference uncertainty cannot reduce the expected social loss. This invalidates EHS' Proposition 4 in this case, because it claims that, for *any* $\bar{a}$, at least some preference uncertainty is beneficial. In particular, EHS' too crude approximations wrongly suggest that preference uncertainty can reduce the expected loss to *below* the first best expected loss (see Appendix A.1; available upon request).

We have used the potential failure of EHS' Proposition 3 as a step toward explaining why their Proposition 4 may fail. However, even in cases in which preference uncertainty *does* reduce Var[y], EHS' Proposition 4 fails when $z = 0$ and $\alpha = \bar{a}$ (as we have just shown). This is due to two factors. Firstly, Appendix A.2 (available upon request) shows that the reduction in output variability as a result of preference uncertainty is smaller than EHS claim. Secondly, the associated increase in inflation variability is larger than EHS claim.[2] As a result, if $z = 0$ and $\alpha = \bar{a}$, the loss from preference uncertainty in terms of higher inflation variability dominates its potential benefit in terms of lower output variability.

3. COMPARISON WITH OTHER DELEGATION ARRANGEMENTS

For a *given* $\bar{a}$, there may be cases in which (some) preference uncertainty is beneficial (see Appendix D; available upon request). However, in this section we show that if the choice of the average degree of "conservatism," $\bar{a}$, is treated as a part of the monetary policy delegation problem (just as σ_x^2 is), then preference uncertainty is undesirable.

Monetary policy delegation in EHS can be viewed as the combination of two steps. First, a value of $\bar{a}$ is selected that may be different from α and that reduces the inflation bias if $\bar{a} > \alpha$ (and assuming that $z > 0$). However, selecting such an $\bar{a}$ distorts stabilization by raising output variability. This distortion may then be addressed by introducing uncertainty about the central banker's preferences, which induces monetary policy to respond more vigorously to supply shocks and, thereby, potentially reduces the output variability again.

The question thus is whether there exist other delegation mechanisms that dominate EHS' arrangement. The answer is yes. If one delegates monetary policy to a central bank with $\bar{a} = \alpha$ and imposes the appropriate inflation contract (in the sense of Walsh 1995) or the appropriate inflation target (in the sense of Svensson 1997) on the central bank, the *second best* is achieved. This is the equilibrium that, for *given* z (and σ_ε^2), achieves the minimum expected social loss. No other arrangement (including one with preference uncertainty) can achieve a lower expected social loss.

Of course, it is conceivable that there are circumstances in which the arrangements proposed by Walsh (1995) or Svensson (1997) cannot be implemented. However, EHS' introduction of two (partially) offsetting distortions (that is, choose an $\bar{a} > \alpha$ and then set $\sigma_x^2 > 0$) begs the question whether the same (or a lower) expected social loss can be reached by simply choosing a better value for $\bar{a}$ (say $\bar{a}^*$), such that $\alpha < \bar{a}^* < \bar{a}$, while setting $\sigma_x^2 = 0$. This setup could produce the same expected inflation rate as under EHS, without feeding uncertainty into the policy responses to the supply shocks. The optimal $\bar{a}^*$ is, of course, the optimal degree of conservatism in the sense of Rogoff (1985).

For the case in which $z > 0$ we have not been able to provide a formal proof of the superiority of the Rogoff scheme.[3] Therefore, we resort to a numerical analysis to see whether it can be dominated by some EHS scheme, that is, one with $\sigma_x^2 > 0$. Because the only distributional characteristic of preference uncertainty that plays a role in EHS' analysis is its variance, σ_x^2, in our computations we assume a two-point distribution for preference uncertainty: $a_t = \bar{a} - \Delta$, with probability 1/2 or $a_t = \bar{a} + \Delta$, with probability 1/2, and with $0 \leq \Delta < \bar{a}$. This allows us to obtain exact closed-form solutions for the expected social loss under the EHS arrangement (see Appendix C; available upon request). We vary each of the parameters α, b and $q \equiv z^2/\sigma_\varepsilon^2$ over the set [0.1,0.5,1,2,10].[4] For a given combination (α,b,q), the optimal EHS delegation scheme is found by varying $\bar{a}$ in steps of $\alpha/1000$ from $\alpha/1000$ to 300α (this range contains the optimal degree of Rogoff conservatism) and varying Δ over the range $[0,\bar{a}/100,2\bar{a}/100,\ldots,99\bar{a}/100]$. We then check all the possible combinations of $(\bar{a},\Delta)$ that can be generated in this way and take the one that yields the lowest expected social loss.

For each of the possible 125 combinations of (α,b,q), the optimal value of Δ turns out to be zero. Hence, although we have not shown formally that the optimal Rogoff delegation scheme cannot be (strictly) dominated by an EHS arrangement with $\sigma_x^2 > 0$, our results suggest that at least for important parts of the parameter space, it is not optimal to have central banker preference uncertainty when it is possible to choose the optimal degree of central bank conservatism right away.

4. ARBITRARY EFFECTS ON AVERAGE MONETARY POLICY IN EHS

In this section we address the modeling strategy on which EHS' analysis is based. In particular, we will argue that the effect of preference uncertainty on average monetary policy reactions is arbitrary. That is, a slight change in the modeling of preference uncertainty can lead to exactly the opposite effect on average monetary policy.

Consider the following amendment of the central bank's loss function:

$$L = \pi^2 + a_t(y - ky^*)^2 . \tag{7}$$

The only difference with Equation (3) is that the stochastic term a_t now appears in front of the output term instead of the inflation term. Otherwise, the specification is analogous to Equation (3). It would seem that this alteration is innocent, because what should matter for the results is uncertainty about the *relative* weight on the inflation versus the output objectives (as is the case with both Equations 3 and 7). However, the alteration is *not* innocent. To see this, solve the model using Equation (7) instead of Equation (3). The central bank's reaction function now becomes

$$\pi = \left[\frac{a_t b}{1 + a_t b^2}\right](b\pi^e + z - \varepsilon) . \tag{8}$$

The crucial difference with Equation (5) is that the slope of the reaction function, the term in square brackets, is now a *concave* function of the stochastic parameter a_t; in Equation (5) the slope is a *convex* function of a_t (remember that $a_t = \bar{a} - x_t > 0$). Hence, as modeled in Equation (7), preference uncertainty causes the central bank, *on average*, to respond *less* to inflation expectations, *less* to the output goal, and *less* vigorously to the supply shock. In effect, preference uncertainty makes the central bank more "conservative" on average. This leads to the opposite of the result in EHS' Proposition 1 ("The greater monetary policy uncertainty (...), the higher expected inflation"). Because there is no obvious reason to prefer specification Equation (3) to Equation (7), EHS' results depend on an arbitrary *average* effect of stochastic preferences on monetary policy responses.[5,6] Apart from the arbitrary direction of the average effect, the central bank will under either specification act *as if* one objective is relatively more important than the other, while the averages of the weights on the individual objectives are actually kept constant. This is undesirable when one studies the implications of changing preference uncertainty.

The following analogous specification (used by Beetsma and Jensen, 1998, who adopt it from Sørensen, 1991) does not lead to the abovementioned average effects on monetary policy. Hence, it enables one to explore the effects of preference uncertainty on policy uncertainty per se:

$$L = a_t\pi^2 + (1 + \bar{a} - a_t)(y - ky^*)^2 . \qquad (9)$$

For the case of $b = 1$, the central bank reaction function now becomes[7]

$$\pi = \left[\frac{1 + \bar{a} - a_t}{1 + \bar{a}}\right](\pi^e + z - \varepsilon) . \qquad (10)$$

In contrast to Equation (5) or Equation (8) the slope of Equation (10) is a *linear* function of a_t. Hence, uncertainty about the central bank's preferences leads to uncertainty about the monetary policy responses, but without any effect on the average response. In addition, specification (9) has the beneficial side effect of providing closed-form solutions for output and inflation.

With Equation (9), preference uncertainty can *never* be beneficial for society (no matter what value one chooses for $\bar{a}$) because it increases the variances of *both* inflation and output, while leaving their averages unaltered. To see this, note that from Equation (10) one finds $E[\pi] = \pi^e = z/\bar{a}$, hence $\pi = [(1 + \bar{a} - a_t)/\bar{a}]z - [(1 + \bar{a} - a_t)/(1 + \bar{a})]\varepsilon$. From Equation (1) (with $b = 1$) it then follows that $y = y^* + [(\bar{a} - a_t)/\bar{a}]\, z + [a_t/(1 + \bar{a})]\varepsilon$. Because a_t and ε are statistically independent, it is easy to see that the variances of both π and y increase with the variance of a_t, and thus with σ_x^2.[8]

5. CONCLUDING REMARKS

On the basis of the preceding analysis, we conclude that EHS' case for introducing central banker preference uncertainty is rather weak. If preference uncertainty only induces policy uncertainty, then it cannot be welfare improving. It can only be beneficial when average monetary policy is affected in a certain direction, which depends on the specific way preference uncertainty is modeled. However, even then, within their setting, its benefit relies on the assumption that monetary policy delegation is suboptimal (in particular, that the central bank is made suboptimally conservative), and that output variability falls with preference uncertainty (which is not necessarily the case).

NOTES

1. If the central bank attaches a relatively high priority to the stabilization of output (that is, $\bar{a}$ is relatively low), then its response to supply shocks is relatively strong. However, in this case, for given

σ_τ^2, there is much uncertainty in the response, which dominates the effect on output variability that would result from the response becoming more vigorous on average due to preference uncertainty. Further, if b is relatively high, the uncertainty in the monetary policy response caused by preference uncertainty feeds more strongly into output variability. This explains why EHS' Proposition 3 is more likely to fail when b is high and $\bar{a}$ is low.

2. Due to an algebraic mistake, EHS' Equation (15) erroneously shows that Var[π] is independent of preference uncertainty for $z = 0$. However, one can easily demonstrate (without resorting to approximations) that Var[π] is *increasing* in preference uncertainty (cf. Appendix A.2; available upon request), and that EHS' understatement of inflation variability also holds when their algebraic mistake is corrected.

3. The superiority of the Rogoff scheme is obviously confirmed when $z = 0$, because delegating monetary policy to a central banker with society's preferences (that is, $\bar{a} = \alpha$ and $\sigma_\tau^2 = 0$) yields the first best equilibrium; cf. section 2.

4. There is no need to vary z^2 and σ_ε^2 separately because the expected social loss can always be expressed in the format $\sigma_\varepsilon^2 H$, where H is an expression that contains q, but not σ_ε^2 separately. Hence, we only need to compare H across the various arrangements.

5. EHS implicitly motivate their specification by noting that average inflation and inflation volatility are positively correlated in their model, which is consistent with most empirical evidence. However, an empirical justification for preferring Equation (3) over Equation (7) would require that for countries with independent central banks the correlation between first and second moments of inflation is higher when preference uncertainty is higher. We are unaware of any existing empirical evidence to support this prediction. Apart from this, the positive correlation between the mean and the variance of inflation, which is often found, could well be caused by factors unrelated to central bank preference uncertainty.

6. In their Appendix B, EHS present a more general specification of the central bank's loss function, which includes both Equation (3) and Equation (7) as special cases. However, they fail to acknowledge that using Equation (7) instead of Equation (3) reverses the effect of preference uncertainty on average monetary policy.

7. Setting $b = 1$ is merely a convenient normalization. For any $b > 0$, loss function (9) should be reformulated as $L = a_t\pi^2 + (1 + \bar{a} - a_t)\ (y - ky^*)^2/b^2$, and the reaction function would become $\pi = [(1 + \bar{a} - a_t)/(1 + \bar{a})]\ (b\pi^e + z - \varepsilon)/b$.

8. This result holds for any $b > 0$ if the loss function is adjusted as in footnote 7 (see Appendix E; available upon request).

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