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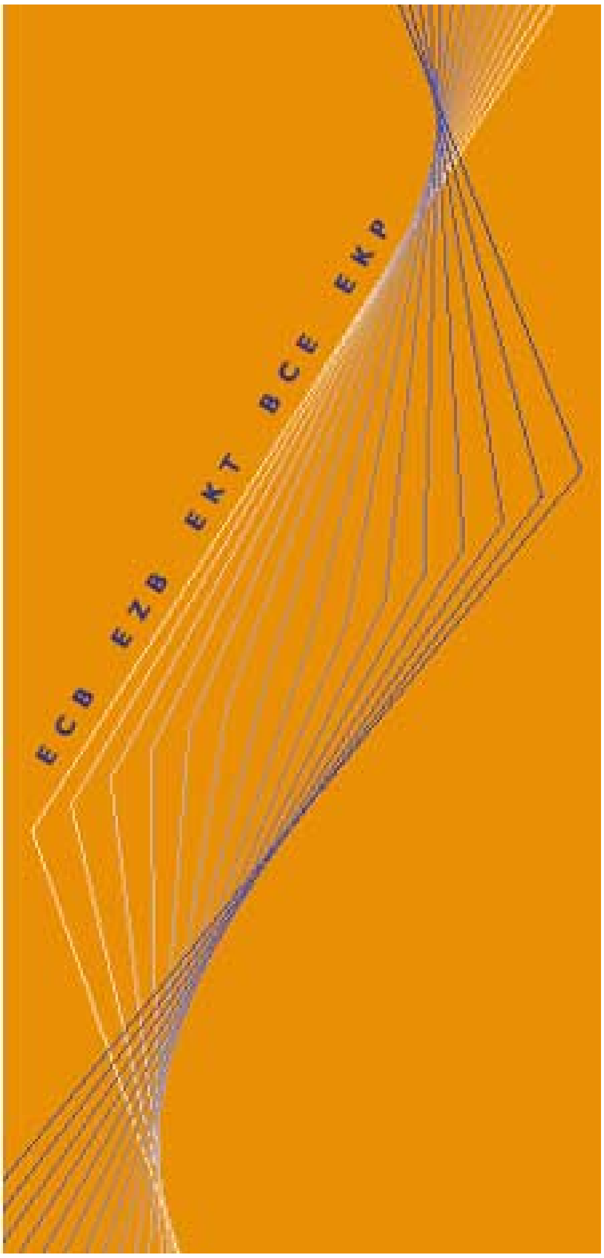

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BY PHILIP SCHELLEKENS

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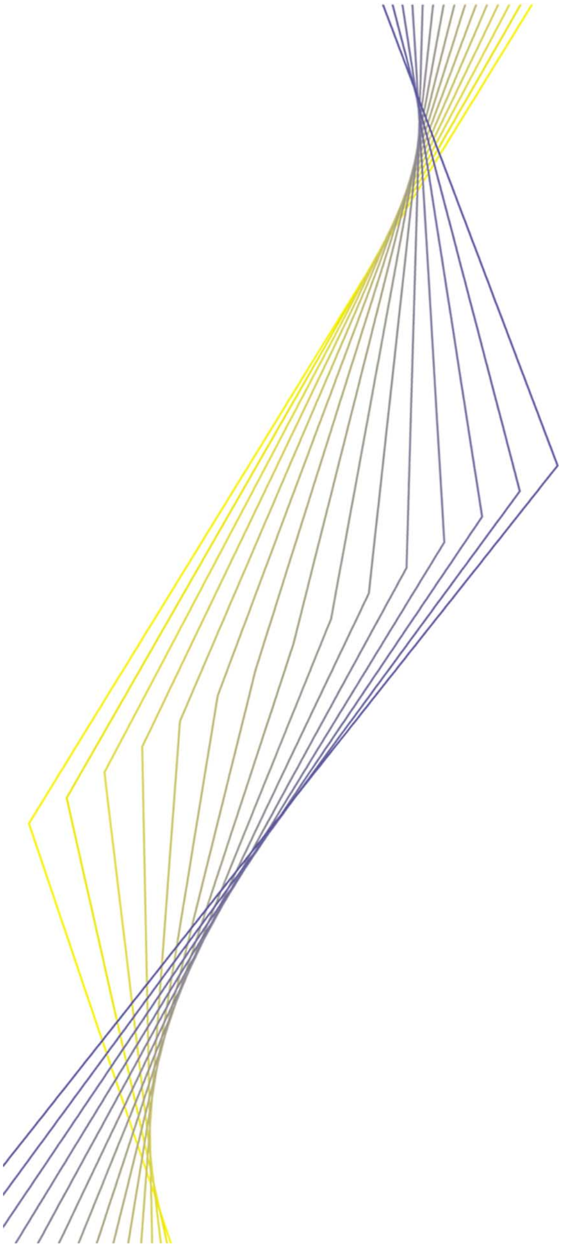

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CAUTION AND CONSERVATISM IN THE MAKING OF MONETARY POLICY

BY PHILIP SCHELLEKENS*

JULY 2000

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Abstract

Does society benefit from the delegation of monetary policy to cautious and conservative central bankers? We offer a critical view on the delegation literature and relax seemingly innocuous assumptions about uncertainty and preferences. First, caution improves credibility but does not obviate the need for central-bank conservatism. Second, previous models of delegation have focused on suboptimal forms of conservatism. We derive optimal concepts of conservatism that mitigate, or eliminate, any residual problem of credibility. Third, we rationalize why credible monetary policy may be conducive to stable inflation and output.

JEL classification: E50

> *"An important reason to expose central bankers to elected officials is that, just as the latter may have an inflationary bias, the former may easily develop a deflationary bias. Shielded as they are from public opinion, cocooned within an anti-inflationary temple, central bankers can all too easily deny ... that cyclical unemployment can be reduced by easing monetary policy." (Stanley Fischer, 1994. p. 293)*

What principles should motivate the conduct and design of monetary policy? Uncertainty about what monetary policy can do and disagreement about what it should do have caused significant controversy on the practical resolution of this question. Uncertainty about the transmission mechanism and disagreement about the optimal form of delegation, in particular, have always complicated the making of policy.

Despite the ongoing debates, policy makers need to take a preliminary stance on how to implement policy. It seems, more often than not, that their practical response has been one of caution and conservatism. As reflected in the above quote, this immediately raises the concern whether caution and conservatism are desirable from a social welfare point of view. And, if they are, there is still the legitimate question whether actual policy makers conduct policy in an excessively cautious and conservative fashion. But in order to answer the latter question, a benchmark is needed, and therefore we first need to answer the former, more fundamental, question: do caution and conservatism improve the making of monetary policy? This is the central theme of this paper.

Caution in this paper refers to a more neutral, or less activist, stance of policy and emerges from the interaction between uncertainty and preferences. Conservatism refers to preferences that are unrepresentative from a social point of view. Our interest in the normative underpinnings of caution and conservatism is motivated by two observations. First, there is an unresolved tension between the popular perception that caution and conservatism are costly and the empirical finding that delegation to independent central bankers is beneficial. If central bankers are cautious and conservative, the latter empirical finding (also known as the 'free lunch result of delegation') seems to suggest that these features are desirable qualities. But is it really true that caution and conservatism are the blessings that generate this result? To answer this question, one must first come up with a social welfare benchmark.

Second, policy makers have felt somewhat uneasy with the descriptive realism of the proposals suggested by the 'credibility literature'. This is reflected, for example, in the call by McCallum (1995, p. 207) to improve the "interpretive *mappings* between analytical constructs and real-world institutions". In reviewing the literature, Blinder (1998) mentions two notable exceptions, however, where minds have actually come together. The first is the so-called Brainard (1967) conservatism principle that rationalizes why policy makers want to err on the side of caution. The second is the Rogoff (1985) conservative-central-banker approach that explains why policy makers with unrepresentative preferences may do things better. There is thus considerable independent interest in jointly analyzing caution and conservatism.

This paper first develops a baseline model of caution that has two key features. The first is multiplicative instrument uncertainty, which is introduced to break certainty-equivalence in the simplest possible manner. The second is a generalization of the standard quadratic objective function, which helps us to identify the preference parameters that generate the caution result. The baseline model then used to examine how the popular notion of weight-conservatism interacts with a motive for caution. The model also allows us to derive new notions of central-bank conservatism that do not distort output stabilization and may in principle restore the best feasible equilibrium. Finally, the model formalizes that "monetary policy can prevent money itself from being a major source of uncertainty" (Friedman, 1968, p. 12) and implies that the *credibility* of monetary policy, too, can help reduce the variability of inflation and output. It is shown that conservatism may generate a strong version of the free lunch result of delegation.

At this stage, it is useful to discuss how our contribution relates to the literature. The uncertainties surrounding the making of monetary policy received considerable attention during the 1960's and early 1970's. Important contributions include those of Brainard (1967) on the effectiveness of policy under multiplicative uncertainty, Friedman (1968) on the merits of fixed rules when lags are long and variable, and Poole (1970) on the choice of an intermediate target under additive uncertainty. The question how policy makers operate under uncertainty has recently received renewed interest. Notable contributions within the standard quadratic paradigm include Swank (1994), Letterie (1997) and Pearce and Sobue (1997). There is also a growing body of research on learning and optimal control theory in dynamic environments with multiplicative uncertainty[1] but none of these contributions addresses the delegation of monetary policy to conservative central banks.

[1] Interestingly, this literature has illustrated the possibility of uncertainty leading to increased policy aggressiveness. See Craine (1979), Sargent (1998) and Onatski and Stock (1998).

With regard to monetary policy delegation, the credibility literature offers a convenient framework. This literature traditionally features a role for policy that is clouded by various policy conflicts, such as the temptation to misuse monetary policy and the trade-off between inflation and output variability. The analysis of monetary policy delegation gained much impetus with the application of the notion of time-inconsistency (Kydland and Prescott, 1977) to monetary economics (Barro and Gordon, 1983a), which led to the discovery of a credibility problem in the form of an inflationary bias. Much of the subsequent literature has then looked for possible mechanisms that reduce or remove this credibility problem without compromising the flexibility needed for output stabilization. Barro and Gordon (1983b) and Canzoneri (1985) suggest reputational forces that may restore the best feasible equilibrium.

One prominent approach suggests the delegation of monetary policy to an independent central banker with *incentives* distinct from those of the government. Walsh (1995) and Persson and Tabellini (1993) have argued that the apparent trade-off between credibility and flexibility arises because the delegation mechanism is restricted to ad-hoc incentive structures. If instead an inflation contract ensuring an optimal incentive structure were introduced, the best feasible equilibrium would prevail with full credibility and flexibility simultaneously. Our approach does bear some similarity to Walsh (1995), who highlighted how restrictive assumptions on the delegation mechanism may generate a credibility-flexibility trade-off. This branch of the credibility literature, however, does not have anything to say about central-bank conservatism. Moreover, as is the case for most of the credibility literature, the issue of caution is ignored: most studies assume that the transmission mechanism is either deterministic or subject only to additive uncertainty.

Instead, we draw on another branch of the credibility literature. Rogoff (1985) proposes the delegation of monetary policy to central banks with divergent *preferences* and shows that the appointment of a 'weight-conservative' central banker improves the problem of imperfect credibility.[2] However, given that the notion of weight-conservatism refers to the relative preference for inflation versus output stabilization, complete removal of the inflationary bias would entail too high a cost in terms of output variability. As a result, a suboptimal equilibrium is obtained and this has been the reason why attention has for some time shifted away from delegation mechanisms based on conservatism.

[2] See also Flood and Isard (1989), Lohmann (1992), Waller (1992), Waller and Walsh (1996).

Recently, a few studies have re-established a role for weight-conservatism by enriching the environment in which the central bank conducts policy. Herrendorf and Lockwood (1997) and Svensson (1997a) suggest that weight-conservatism may be useful when the inflationary bias is state-contingent and the delegation decision is not. Rather than enriching the environment so that a role for weight-conservatism re-emerges, our approach suggests a review of the notion of weight-conservatism itself.

An interesting contribution that also reconsiders the concept of conservatism is Svensson (1997b). He shows that conservatism in the form of a lower inflation *target* may lead to the best feasible equilibrium, where inflation settles down at its socially optimal level. However, as suggested by King (1997), this proposal raises doubts as it is implied that central banks should target inflation rates that are anticipated to be missed systematically.

The organization of the paper is as follows. Section 1 develops the baseline model. Section 2 discusses monetary policy delegation under standard quadratic preferences. Section 3 introduces generalized preferences and derives optimal notions of conservatism. Section 4 applies the model to the free lunch result of delegation. The last section concludes.

1 Caution in the Making of Monetary Policy

1.1 Description of the Model

We begin with a description of the economic environment. Aggregate supply is represented by a standard surprise supply function:

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

where y is log of output, y^* is log of natural output, π is inflation, π^e is expected inflation, and ε is a temporary aggregate supply shock with mean 0 and variance σ_ε^2.

Aggregate demand is controlled by a policy maker, who can generate surprise inflation. Let i^p denote the planned deviation of the policy maker's single instrument from its neutral level. However, due to multiplicative uncertainty control is imperfect:

$$\pi = s\, i^p \,, \tag{2}$$

where s is a shock with mean 1 and variance σ_s^2. All variances in the model are strictly positive and finite. For analytical convenience, supply and control shocks are independent of each other. The assumption of multiplicative instrument uncertainty marks a first departure from the literature which generally assumes that transmission is either deterministic or subject only to additive uncertainty.[3]

The multiplicative nature of the shock is meant to reflect that policy makers are more agnostic about the consequences of their actions, the larger the policy deviation they wish to introduce. The specification implies that loose monetary policy is associated with more variable inflation. This result has strong empirical foundations (Taylor, 1981; Ball and Cecchetti, 1990) and has also been rationalized theoretically. Judd and Scadding (1982), for example, argue that high inflation encourages financial innovation, which can lead to more difficult monetary control. Holland (1993) explains how the interaction between inflation uncertainty and heterogeneity of pricing policies at the firm level leads to worse monetary control at high levels of money growth.

The description of the monetary policy game is standard. There are two players: a private sector and a policy maker. Before locking itself into a nominal wage contract, the private sector formulates a prediction (π^e) about the increase in the price level during the duration of the contract. The strategy of the policy maker is to choose the degree of policy intervention (i^p). The timing is as follows. At time one, the private sector optimally chooses π^e. At time two, a supply shock ε is realized. At time three, the policy maker optimally chooses instrument i^p. At time four, a control shock s is realized and inflation, output and the payoffs of the players are determined. The information set of the private sector at time one only includes the structure of the model, whereas that of the policy maker at time three also includes the realization of the supply shock. At the times of their respective decisions, both players are uninformed about the future realization of the control shock.

The private sector's objective is to minimize forecast errors. Optimal prediction requires $\pi^e = E[\pi]$, where $E[\pi]$ denotes the mathematical expectation over the inflation rate, conditional on the private sector's information set at time one.

The description of the policy maker's objective function marks a second departure from previous work, which generally assumes standard quadratic preferences. We propose

[3] The simple representation in (2) merely serves to break certainty-equivalence. In practice, randomness in the relation between policy instrument and policy goal is the result of various, possibly conflicting, forces. Control also becomes more difficult depending on whether one wishes to affect instruments, operating targets, intermediate targets or ultimate policy goal variables. Shocks to the interest elasticities of money demand and aggregate demand are examples of factors that constrain the policy maker's ability to control inflation in an accurate manner.

the following extension which will be termed the 'generalized quadratic objective function':

$$\begin{aligned}\Omega \;=\;& \mu_1 \left(E\left[\pi\right]\right)^2 \;+\; \theta_1 Var\left[\pi\right] \\ &+\; \mu_2 \left(E\left[y\right] - ky^*\right)^2 \;+\; \theta_2 Var\left[y\right] \;, \end{aligned} \tag{3}$$

where μ_1, μ_2, θ_1 and $\theta_2 \geq 0$ and $k > 1$. The policy maker is assumed to be concerned about inflation and output. The objective function reflects, for each variable, the cost of the mean-squared bias (MSB) around the target and the cost of variability around the mean. The inflation target has been set to zero. The output target equals ky^* and exceeds the natural rate (as $k > 1$). In what follows, the gap between the natural rate and the target rate of output will be denoted by $z \equiv (k-1)y^* > 0$.

The novelty of the generalized objective function lies in the separation of the costs of expected and unexpected deviations in inflation and output. Parameters μ_1 and μ_2 measure the intensity of the policy maker's aversion to systematically missing the inflation and output target. Parameters θ_1 and θ_2 measure the policy maker's preference for nominal and real stability. Note that the simple quadratic objective function obtains as a special case of (3) where $\mu_1 = \theta_1$ and $\mu_2 = \theta_2$. Setting $\mu_1 = \theta_1 = \alpha$ and $\mu_2 = \theta_2 = 1$, we obtain:

$$Q \;=\; E\left[\,\alpha\pi^2 + (y - ky^*)^2\,\right], \tag{4}$$

where α is the relative weight the policy maker attaches to inflation versus output stabilization around the targets.

We can think of a normative and a political economy justification for the proposed objective function. From a normative perspective, it may well be the case that society values expected versus unexpected deviations asymmetrically (resulting in $\mu_1 \neq \theta_1$ and/or $\mu_2 \neq \theta_2$). For example, if shoe-leather costs of inflation are primarily associated with expected inflation and the costs of relative price distortion with unexpected inflation, society may find expected inflation relatively more costly ($\mu_1 > \theta_1$) if shoe-leather costs are relatively larger. All we need is that expected and unexpected deviations produce different types or magnitudes of costs. From a political economy perspective, even if social preferences are represented by the standard quadratic objective function, there may still be an interest in delegating monetary policy to an agent who is asked to conduct policy according to the generalized quadratic objective function.

The generalized objective function serves a double purpose in this paper. First, with regard to the analysis of caution, it will make sense to focus not only on 'risk' (measured by σ_s^2) but also on the 'price of risk' (measured by θ_1 and θ_2). Second, with regard to the role of conservatism, policy maker heterogeneity in terms of μ_1, μ_2, θ_1 and θ_2 will prove helpful in the design of optimal delegation mechanisms.

1.2 Equilibrium

We now look for a time-consistent equilibrium. Thanks to the linear-quadratic nature of the problem, the policy maker's strategy is given by the following linear policy reaction function:

$$i^p = \lambda_1 + \lambda_2 \epsilon.$$

The rate of inflation that follows from this reaction function is therefore:

$$\pi = s\left(\lambda_1 + \lambda_2 \epsilon\right). \tag{5}$$

Taking rational expectations over (5), the private sector's optimal strategy is to set $\pi^e = \lambda_1$.

The policy maker's optimal choice of λ_1 and λ_2 minimizes (3) subject to the strategy of the private sector, the specification of uncertainty, and (1) and (2). After a little algebra, the objective function can be rewritten as:

$$\begin{aligned}\Omega\left(\lambda_1, \lambda_2\right) &= \mu_1 \left\{ \lambda_1^2 \right\} \\ &+ \mu_2 \left\{ \left(b\lambda_1 - b\pi^e - z\right)^2 \right\} \\ &+ \theta_1 \left\{ \sigma_\epsilon^2 \lambda_2^2 + \sigma_s^2 \left(\lambda_1^2 + \sigma_\epsilon^2 \lambda_2^2\right) \right\} \\ &+ \theta_2 \left\{ \sigma_\epsilon^2 \left(1 + b\lambda_2\right)^2 + b^2 \sigma_s^2 \left(\lambda_1^2 + \sigma_\epsilon^2 \lambda_2^2\right) \right\},\end{aligned} \tag{6}$$

where the first two lines display the mean-squared biases for inflation and output and the last two lines the respective variances.

It is instructive to examine how the four terms in (6) are affected by λ_1 and λ_2. The *credibility* part of the policy rule (λ_1) shows up in all four terms. The *stabilization* part of the policy rule (λ_2) matters only for the variance terms. As in the standard literature, optimal stabilization policy trades off the benefit of lower output variability against the cost of higher inflation variability. But now, with multiplicative uncertainty, the policy maker also needs to take into account the consequences of policy non-neutrality ($\lambda_1 \neq 0$ or $\lambda_2 \neq 0$) for the variability in inflation and output.

The first-order conditions for λ_1 and λ_2 are:

$$\mu_1\lambda_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)\lambda_1 = b\mu_2\left(z + b\pi^e - b\lambda_1\right) \times \left(1 - \frac{\partial \pi^e}{\partial \lambda_1}\right) , \tag{7}$$

$$\left(1 + \sigma_s^2\right)\left(\theta_1 + b^2\theta_2\right)\sigma_\epsilon^2\lambda_2 = -\, b\,\theta_2\sigma_\epsilon^2 , \tag{8}$$

where π^e is to be evaluated at λ_1.

Equation (7) illustrates the problem of time-inconsistency. If a formal commitment technology were to exist, the policy maker could commit to fully take into account the endogeneity of expected inflation with respect to the policy regime (i.e. $\partial\pi^e/\partial\lambda_1 = 1$). The solution under commitment (c) would then be given by $i^p = \lambda_1^c + \lambda_2^c\epsilon$ with

$$\lambda_1^c = 0 ,$$
$$\lambda_2^c = -\frac{b\,\theta_2}{\left(1+\sigma_s^2\right)\left(\theta_1 + b^2\theta_2\right)} .$$

However, if no formal commitment technology exists, the endogeneity of expected inflation is not internalized ($\partial\pi^e/\partial\lambda_1 = 0$). Optimal policy is then time-inconsistent and time-consistent policy is suboptimal (Kydland and Prescott, 1977) with:

$$\lambda_1 = \frac{b\,\mu_2\,z}{\mu_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)} , \tag{9}$$

$$\lambda_2 = -\frac{b\,\theta_2}{\left(1+\sigma_s^2\right)\left(\theta_1 + b^2\theta_2\right)} , \tag{10}$$

where the λ's without superscripts refer to the no-commitment or discretionary solution. The equilibrium policy reaction function is therefore given by:

$$i^p = \frac{b\,\mu_2\,z}{\mu_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)} - \frac{b\,\theta_2}{\left(1+\sigma_s^2\right)\left(\theta_1 + b^2\theta_2\right)}\,\epsilon . \tag{11}$$

Finally, the equilibrium realizations of inflation and output equal:

$$\pi = s\left(\lambda_1 + \lambda_2\epsilon\right) ,$$
$$y = y^* + (s-1)\,b\lambda_1 + \left(1 + sb\lambda_2\right)\epsilon ,$$

where λ_1 and λ_2 are given by (9) and (10).

1.3 Properties of Equilibrium

The model delivers the standard inflationary bias:

$$E\left[\pi\right] = \frac{b\,\mu_2\,z}{\mu_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)} , \tag{12}$$

whereas output remains at the natural nevel. The bias increases with the output distortion (z) and decreases with the relative preference for the inflation versus the output target (μ_1/μ_2). The bias is further moderated by the policy maker's motive for caution. As in Brainard (1967), caution emerges from the interaction between multiplicative uncertainty and an aversion to variability. Given that the private sector rationally predicts the policy maker's reduced aggressiveness, caution reduces the bias. This point was originally formulated in the standard quadratic paradigm by Swank (1994) and Pearce and Sobue (1997).[4] By separating out the preference parameters that really matter (namely θ_1 and θ_2), the generalized quadratic objective function allows us to focus more explicitly on what drives the caution result.

The variability of inflation in this economy is given by:

$$Var\left[\pi\right] = \left(\frac{b\,\theta_2}{\theta_1 + b^2\theta_2}\right)^2 \frac{\sigma_\epsilon^2}{1+\sigma_s^2} \;+\; \left(\frac{b\,\mu_2\,z}{\mu_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)}\right)^2 \sigma_s^2. \tag{13}$$

To interpret this expression, note that the first term derives from the policy maker's desire to stabilize output. This desire is moderated due to the presence of control shocks ($\sigma_s^2 > 0$), which make the policy maker cautious. The second term reflects the fact that systematic policy non-neutrality leads to unwanted inflation variability through the multiplicative shocks.

The variability of output is given by:

$$Var[y] = \left(\left(\frac{\theta_1}{\theta_1 + b^2\theta_2}\right)^2 + \sigma_s^2\right) \frac{\sigma_\epsilon^2}{1+\sigma_s^2} \;+\; b^2\left(\frac{b\,\mu_2\,z}{\mu_1 + \sigma_s^2\left(\theta_1 + b^2\theta_2\right)}\right)^2 \sigma_s^2. \tag{14}$$

The first term again corresponds to the stabilization desire of the central bank. The second term reflects the fact that systematic policy non-neutrality leads to more output volatility as control shocks have more scope to drive a wedge between actual and expected inflation.

2 Monetary Policy Delegation with Standard Quadratic Objectives

The previous section has shown how the interaction between uncertainty and preferences produces caution in the conduct of monetary policy. The generalized quadratic objective function allowed us to identify preference parameters θ_1 and θ_2 as the driving force behind

[4] An indirect mechanism that delivers a similar result was proposed by Devereux (1987): uncertainty induces wage setters to index nominal contracts. This reduces the effectiveness of surprise inflation and the temptation to surprise.

this result. Clearly, if these preferences are socially representative, a cautious setting of the instrument is always socially optimal.

In what follows, we examine the delegation of monetary policy to agents whose preferences are socially unrepresentative. In particular, we study various forms of central-bank conservatism and ask whether these improve social welfare. We first keep with the standard quadratic paradigm and re-examine the notion of weight-conservatism in a setting with multiplicative instrument uncertainty. Later, we examine new notions of conservatism that follow from the introduction of generalized quadratic objectives.

Denote the objective functions of the government and the central bank by:

$$\begin{aligned} Q &= E\left[\, \alpha\, \pi^2 + (y - ky^*)^2 \,\right] \ , \\ Q^* &= E\left[\, \alpha^* \pi^2 + (y - ky^*)^2 \,\right] \ . \end{aligned}$$

The central bank is then said to be weight-conservative if $\alpha^* > \alpha$. Rogoff (1985) showed that delegation to a weight-conservative central banker reduces the inflationary bias at the expense of output stabilization. And, since the former effect initially dominates the latter, a finite degree of weight-conservatism generally improves overall welfare.

But does weight-conservatism continue to make sense if policy is already conducted cautiously? Indeed, one may argue that caution substitutes for weight-conservatism. After all, caution also results in lower average inflation and reduced policy responsiveness to shocks.[5]

To answer this question, impose restrictions $\mu_1 = \theta_1 = \alpha^*$ and $\mu_2 = \theta_2 = 1$ on Equations (12), (13) and (14) of the baseline model. A weight-conservative central banker indexed by α^* then delivers the following equilibrium:

$$E\,[\pi] = \frac{bz}{\alpha^* + \sigma_s^2(\alpha^* + b^2)} \ , \tag{15}$$

$$Var\,[\pi] = \left(\frac{b}{\alpha^* + b^2}\right)^2 \frac{\sigma_\epsilon^2}{1+\sigma_s^2} + \left(\frac{b\,z}{\alpha^* + \sigma_s^2\,(\alpha^* + b^2)}\right)^2 \sigma_s^2 \ , \tag{16}$$

$$Var[y] = \left(\left(\frac{\alpha^*}{\alpha^* + b^2}\right)^2 + \sigma_s^2\right) \frac{\sigma_\epsilon^2}{1+\sigma_s^2} + b^2 \left(\frac{b\,z}{\alpha^* + \sigma_s^2\,(\alpha^* + b^2)}\right)^2 \sigma_s^2 \tag{17}$$

[5] Pearce and Sobue (1997) also hinted at the possible substitutability between caution and weight-conservatism (cf. Footnote 7 in their paper).

and $E[y] = y^*$. To derive the optimal degree of weight-conservatism, substitute the above expressions into the government's objective function and differentiate with respect to α^*. The algebra in the Appendix then leads to the following proposition:

PROPOSITION 1: *(i) Weight-conservatism continues to improve social welfare. (ii) Let* $\omega \equiv 3\alpha + 2b^2\sigma_s^2 / \left(1 + \sigma_s^2\right)$ *. If moderate conservatism (*$\alpha^* < \omega$*) is optimal initially, more uncertainty leads to less conservatism. If ultra-conservatism (*$\alpha^* > \omega$*) is optimal initially, more uncertainty leads to more conservatism.*

The Appendix provides a proof. From (i), it follows that Rogoff's (1985) analysis is robust to settings with multiplicative instrument uncertainty. The intuition here is as follows. Caution reduces the bias and the policy responsiveness to shocks. Although the policy response to shocks changes, it remains socially optimal. Weight-conservatism also reduces the bias and the responsiveness of policy to shocks. But, unlike caution, weight-conservatism distorts the policy response away from what is socially optimal. Because the benefit of lower average inflation initially dominates the cost of more variable output, the optimal scheme involves a finite degree of weight-conservatism.

To interpret (ii), note that moderate conservatism is typically optimal when the degree of output volatility is large relative to the size of the inflationary bias. Increased uncertainty induces caution, which reduces the policy response to shocks. In an environment with an already significant degree of output volatility, this is particularly costly. To offset some of the increased volatility, weight-conservatism is optimally reduced. If ultra-conservatism were optimal initially, this trade-off no longer holds. Ultra-conservatism may be justified on the basis that the inflationary bias is much more of a problem than the volatility of output. In this environment, the use of monetary policy for output stabilization becomes increasingly second-order to the role that weight-conservatism can play in reducing the inflationary bias. Although increased uncertainty reduces the policy response to shocks, weight-conservatism is now optimally increased.

3 Monetary Policy Delegation with Generalized Quadratic Objectives

Weight-conservatism continues to improve, but does not remove, the credibility problem of monetary policy. But why does the government not design a scheme that requires the central banker to behave conservatively in some *optimal* fashion? We now derive optimal notions of central-bank conservatism based on the generalized quadratic objective function.

Assume that the objectives of the government and central bank are given by:

$$\begin{aligned}\Omega &= \mu_1 (E[\pi])^2 + \mu_2 (E[y] - ky^*)^2 + \theta_1 Var[\pi] + \theta_2 Var[y] \ , \\ \Omega^* &= \mu_1^* (E[\pi])^2 + \mu_2^* (E[y] - ky^*)^2 + \theta_1^* Var[\pi] + \theta_2^* Var[y] \ ,\end{aligned}$$

where the starred coefficients refer to the preference parameters of the central bank.

3.1 Stability-Conservatism

We first derive an alternative notion of central-bank conservatism that is based on preference parameters θ_1^* and θ_2^*. Recall that these measure the preference intensities of the central bank for nominal and real stability. If we wish to retain the socially optimal stabilization mix, it must be the case that $\theta_1^*/\theta_2^* = \theta_1/\theta_2$. This implies that $\theta_1^* = \chi^*\theta_1$ and $\theta_2^* = \chi^*\theta_2$, where χ^* measures the central bank's overall concern for stability. The notion of 'stability-conservatism' then refers to the case where the central banker has a stronger overall preference for stability than the government has. This would correspond to $\chi^* > \chi \equiv 1$.

The policy reaction function of a stability-conservative central banker is given by:

$$i^p = \frac{b\,\mu_2\,z}{\mu_1 + \chi^*\,\sigma_s^2\,(\theta_1 + b^2\theta_2)} - \frac{b\,\theta_2}{(1+\sigma_s^2)\,(\theta_1 + b^2\theta_2)}\,\epsilon \ .$$

The first part of this expression is the credibility term. Because of the central bank's stronger preference for nominal and real stability, uncertainty is now χ^* times more costly. This induces more caution which in turn reduces the inflationary bias. The second part is the stabilization term, which by construction is not affected. Unlike weight-conservatism, stability-conservatism does not distort output stabilization.

PROPOSITION 2: *Delegation of monetary policy to a central banker with an exclusive concern for stability ($\chi^* \to \infty$) leads to the constrained welfare optimum.*

The proof follows simply from the observation that credibility can be improved without introducing additional distortions.

The notion of stability-conservatism seems to accord with the fact that successful monetary policy is often attributed to the penchant of central banks for stability. The model suggests that central bankers with a penchant for stability exercise more caution in response to the uncertainties surrounding their policy decision. Thus, conservatism reinforces caution and their combination achieves the constrained social welfare optimum.[6]

3.2 Target-Conservatism

With the generalized quadratic objective function we can also derive a notion of central-bank conservatism that is based on preference parameters μ_1^* and μ_2^*. A central banker is said to be 'target-conservative' if, in comparison with the government, more importance is attached to the inflation target than to the output target. This corresponds to $\mu_1^*/\mu_2^* > \mu_1/\mu_2$.

The policy reaction function of a target-conservative central banker is given by:

$$i^p = \frac{b\,\mu_2^*\,z}{\mu_1^* + \sigma_s^2\,(\theta_1 + b^2\theta_2)} - \frac{b\,\theta_2}{(1+\sigma_s^2)\,(\theta_1 + b^2\theta_2)}\,\epsilon\,.$$

Again, only the credibility part of the policy rule is affected. Stabilization remains optimal throughout.[7] It is straightforward to see that extreme target-conservatism ($\mu_2^* = 0$) leads to the constrained welfare optimum.[8]

An inflation-targeting regime is of course a natural candidate when we look for an empirical counterpart of an institutional set-up that introduces a degree of target-conservatism. Moreover, target-conservatism reduces average inflation without compromising on the stabilization of output. This is in concert with the claim by practitioners that inflation targeting need not imply that the stabilization of output is ignored (Bernanke and Mishkin, 1997; King, 1997).

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[6] Note that the act of delegation to conservative central bankers is discretionary. Therefore, whether or not credibility can be restored ultimately depends on the cost of changing the monetary regime. This point, put forward by McCallum (1995), was formalized by Jensen (1998).

[7] Note that target-conservatism, unlike stability-conservatism, continues to play a useful role in environments without multiplicative instrument uncertainty.

[8] This result has already been suggested by various atuhors. See, for example, Blinder (1998, p. 43, no emphasis added): "a disarmingly simple solution to the Kydland-Prescott problem [is to] *direct* the central bank to behave as if it prefers $[y^*]$ rather than $[ky^*]$".

4 Application: The Free Lunch Result of Delegation

Empirical studies have suggested that the delegation of monetary policy to an independent central bank is like a free lunch: it lowers inflation without increasing the variability of output.[9] At the theoretical level, this has created an anomaly in the Rogoff (1985) model, which predicts higher output variability in response to weight-conservatism. Subsequent research has shown that the free lunch result may be explained by (i) the offsetting interaction between higher 'economic variability' due to increased weight-conservatism and lower 'political variability' due to better insulation from the political business cycle (Alesina and Gatti, 1995); (ii) a positive correlation between the degree of central bank independence and the ability to stabilize or the degree of fiscal discipline (Fischer, 1995); (iii) the presence of a second-best delegation scheme (Svensson, 1997b).

This paper argues that conservatism may be consistent with a strong version of the free lunch result:

PROPOSITION 3: *In the presence of multiplicative instrument uncertainty, stability-conservatism and target-conservatism enhance both nominal and real stability.*

The proof follows from the inspection of (13) and (14). To interpret this result, consider the consequences of stability- and target-conservatism for output variability (the effect on inflation variability is entirely analogous). The variance of output is given by:

$$Var[y] = \left(\left(\frac{\theta_1}{\theta_1 + b^2\theta_2}\right)^2 + \sigma_s^2\right) \frac{\sigma_\epsilon^2}{1+\sigma_s^2} \; + \; b^2 \left(\frac{b\,\mu_2\, z}{\mu_1 + \chi^*\sigma_s^2\,(\theta_1 + b^2\theta_2)}\right)^2 \sigma_s^2$$

in the case of stability-conservatism, and

$$Var[y] = \left(\left(\frac{\theta_1}{\theta_1 + b^2\theta_2}\right)^2 + \sigma_s^2\right) \frac{\sigma_\epsilon^2}{1+\sigma_s^2} \; + \; b^2 \left(\frac{b\,\mu_2^*\, z}{\mu_1^* + \sigma_s^2\,(\theta_1 + b^2\theta_2)}\right)^2 \sigma_s^2$$

in the case of target-conservatism. Note that, in both cases, conservatism does not affect the first term and lowers the second term. The first term is unaffected precisely because stability- and target-conservatism are *optimal* forms of conservatism. The second term decreases because both stability- and target-conservatism are conducive to a more neutral average stance of policy. A stronger tendency towards policy neutrality reduces the nuisance of multiplicative randomness.

[9] See Alesina and Summers (1993), Debelle and Fischer (1994) and Fischer (1995).

With reference to the earlier quote from Friedman (1968) on page 3, this result implies that the *credibility* of monetary policy, too, can help preventing money from being a source of variability. The implications for the free lunch result of delegation are thus twofold. First of all, delegation to a conservative central banker does not entail suboptimal output stabilization if conservatism is not arbitrarily restricted to the notion of weight-conservatism. Alternative forms of conservatism, such as stability-conservatism and target-conservatism, reduce the inflationary bias without distorting the stabilization of output. Second, *any* delegation scheme which improves or removes the credibility problem of monetary policy reduces at the same time the variability of output (and of inflation), if the transmission of monetary policy is subject to multiplicative uncertainty.

The overall theoretical implication is thus, surprisingly, that delegation based on optimal notions of conservatism should not only lead to lower inflation but also to less variable output. Strictly speaking, the empirical finding that delegation does not affect output variability could then be taken as evidence that the delegation schemes in place are not optimal. Observers may in fact argue that central banks favor nominal stability to real stability ($\theta_1^*/\theta_2^* > \theta_1/\theta_2$), leading to suboptimal output stabilization but possibly identical degrees of output variability across institutional regimes.

Concluding Remarks

This paper has addressed the question whether society benefits from the delegation of monetary policy to cautious and conservative central bankers. The framework that we have used extends the credibility literature with a more general description of preferences and uncertainty. We have made three points. First, while caution reduces the inflationary bias at the cost of a less aggressive response to output shocks, this does not obviate the role for weight-conservatism. Weight-conservatism remains helpful in further reducing average inflation although an interesting trade-off emerges between the degree of uncertainty and the optimal level of weight-conservatism. Economies characterized by a large credibility problem will benefit from delegation to central bankers who become increasingly 'ultra-conservative' in the face of greater uncertainty. Second, and this is the key insight, the paper suggests a reconsideration of the concept of conservatism. Previous work has generally focused on suboptimal concepts. With a more flexible specification of preferences, we have derived new notions of conservatism termed 'stability-conservatism' and 'target-conservatism'. These can in principle restore the best feasible equilibrium. Third, the conservative-central-banker approach is not necessarily inconsistent with the free lunch result of delegation. We have shown how conservatism may not only lead to lower inflation but also to a lower variability of output.

We close with some limitations of the model and ideas for future work. For reasons of comparability, we have preferred to keep with the credibility literature and therefore chose the simplest possible description of monetary policy transmission. Adding a dynamic structure to the transmission mechanism would be a worthwhile extension. Another limitation is that the model features purely exogenous transmission uncertainty and that it abstracts from the issue of learning. We have not developed the model in this direction. Nevertheless, as suggested by Caplin and Leahy (1996), the possibility of learning should be kept in mind, especially if systematic search behavior of the policy maker influences the response of the private sector to policy. Finally, the model abstracts from the endogeneity of preferences to economic outcomes. Future work could analyze whether the interaction between variability and aversion to variability leads to monetary arrangements designed to foster stability in the future.

Appendix

Substitution of Equations (15), (16) and (17) into the government objective function leads to:

$$Q = \left(\frac{\alpha b^2 + \alpha^{*2} + \sigma_s^2 \left(\alpha^* + b^2\right)^2}{\left(\alpha^* + b^2\right)^2} \right) \frac{\sigma_\varepsilon^2}{1 + \sigma_s^2} + \frac{\alpha + \sigma_s^2(\alpha + b^2)}{\left(\alpha^* + \sigma_s^2(\alpha^* + b^2)\right)^2} b^2 z^2 + z^2 .$$

The proof of the first part of Proposition 1 then follows from inspection of the following partial derivative:

$$\frac{\partial Q}{\partial \alpha^*} = -\frac{\left(\alpha + \sigma_s^2(\alpha + b^2)\right)\left(1 + \sigma_s^2\right)}{\left(\alpha^* + \sigma_s^2(\alpha^* + b^2)\right)^3} b^2 z^2 + \frac{(\alpha^* - \alpha)}{\left(1 + \sigma_s^2\right)\left(\alpha^* + b^2\right)^3} b^2 \sigma_\varepsilon^2 . \tag{A1}$$

First, note that, for $0 \leq \alpha^* \leq \alpha$, the first term in (A1) is strictly negative while the second one is only weakly negative. As a result, $\partial Q / \partial \alpha^* < 0$. Second, the sign of $\partial Q / \partial \alpha^*$ must become positive for large values of α^*. To see this, note that the first term in (A1) is negative while the second term is positive (for $\alpha^* > \alpha$). Both terms converge to 0 as α^* approaches $+\infty$. The first term converges at rate α^{*-3}, while the second term converges only at rate α^{*-2}. Consequently, $\partial Q / \partial \alpha^*$ must become positive as $\alpha^* \to +\infty$.

To prove the second part of Proposition 1, rewrite (A1) as:

$$\Phi \;\equiv\; \frac{\left(\alpha+\sigma_s^2(\alpha+b^2)\right)\left(\alpha^*+b^2\right)^3\left(1+\sigma_s^2\right)^2}{\left(\alpha^*+\sigma_s^2(\alpha^*+b^2)\right)^3} \times \left(\frac{z}{\sigma_\varepsilon}\right)^2 \;+\; \alpha \;-\; \alpha^* \;=\; 0.$$

Implicit differentiation yields:

$$\frac{d\alpha^*}{d\sigma_s^2} \;=\; -\,\frac{\Phi_{\sigma_s^2}}{\Phi_{\alpha^*}}\,,$$

where $\Phi_{\sigma_s^2}$ and Φ_{α^*} are given by:

$$\frac{\partial\Phi}{\partial\sigma_s^2} \;=\; \frac{b^2\left(1+\sigma_s^2\right)\left(\alpha^*+b^2\right)^3\left[\left(\alpha^*-3\alpha\right)\left(1+\sigma_s^2\right)-2b^2\sigma_s^2\right]}{\left(\alpha^*+\sigma_s^2(\alpha^*+b^2)\right)^4} \times \left(\frac{z}{\sigma_\varepsilon}\right)^2\,,$$

$$\frac{\partial\Phi}{\partial\alpha^*} \;=\; \frac{-3b^2\left(\alpha+\sigma_s^2(\alpha+b^2)\right)\left(\alpha^*+b^2\right)^2\left(1+\sigma_s^2\right)^2}{\left(\alpha^*+\sigma_s^2(\alpha^*+b^2)\right)^4} \times \left(\frac{z}{\sigma_\varepsilon}\right)^2 \;-\; 1.$$

These partial derivatives can be signed as follows:

$$\Phi_{\sigma_s^2} \;\propto\; \left(\alpha^*-3\alpha\right)\left(1+\sigma_s^2\right)-2b^2\sigma_s^2\,,$$

$$\Phi_{\alpha^*} \;<\; 0.$$

Hence, we have:

$$\frac{d\alpha^*}{d\sigma_s^2} \;<\; 0 \quad\Leftrightarrow\quad \alpha^* \;<\; 3\alpha+\frac{2b^2\sigma_s^2}{1+\sigma_s^2} \;\equiv\; \omega.$$

This completes the proof.

References

Alesina, Alberto and Summers, Lawrence H. "Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence." *Journal of Money, Credit, and Banking*, May 1993, *25*(2), pp. 151-62.

Alesina, Alberto and Gatti, Roberta. "How Independent Should the Central Bank Be?" *American Economic Review*, May 1995 *(Papers and Proceedings)*, *85*(2), pp. 196-200.

Ball, Laurence and Cecchetti, Stephen G. "Inflation and Uncertainty at Long and Short Horizons." *Brookings Papers on Economic Activity*, 1990, (1*)*, pp. 215-54.

Barro, Robert J. and Gordon, David B. "A Positive Theory of Monetary Policy in a Natural Rate Model." *Journal of Political Economy*, August 1983a, *91*(4), pp. 589-610.

________. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics*, July 1983b, *12*(1), pp. 101-21.

Bernanke, Ben S. and Mishkin, Frederic S. "Inflation Targeting: A New Framework for Monetary Policy?" *Journal of Economic Perspectives*, Spring 1997, *22*(2), pp. 97-116.

Blinder, Alan S. *Central Banking in Theory and Practice*. Cambridge, MA; London: MIT Press, 1998.

Brainard, William C. "Uncertainty and the Effectiveness of Policy." *American Economic Review*, June 1967, *57*(3), pp. 411-25.

Canzoneri, Matthew B. "Monetary Policy Games and the Role of Private Information." *American Economic Review*, December 1985, *75*(5), pp. 1056-1070.

Caplin, Andrew and Leahy, John. "Monetary Policy as a Process of Search." *American Economic Review*, September 1996, *86*(4), pp. 689-702.

Craine, Roger. "Optimal Monetary Policy with Uncertainty." *Journal of Economic Dynamics and Control*, February 1979, *1*(1), pp. 59-83.

Debelle, Guy and Fischer, Stanley. "How Independent Should a Central Bank Be?," in Jeffrey C. Fuhrer, ed., *Goals, Guidelines and Constraints Facing Monetary Policymakers*, Conference Series, no. 38, Boston: Federal Reserve Bank of Boston, 1994, pp. 195-221.

Devereux, Michael. "The Effects of Monetary Variability on Welfare in a Simple Macroeconomic Model." *Journal of Monetary Economics*, May 1987, *19*(3), pp. 427-35.

Fischer, Stanley. "Modern Central Banking," in Forrest Capie et al., eds., *The Future of Central Banking*, Cambridge, England; New York; Melbourne: Cambridge University Press, 1994, pp. 262-308.

________. "Central-Bank Independence Revisited." *American Economic Review*, May 1995 *(Papers and Proceedings)*, *85*(2), pp. 201-206.

Flood, Robert P. and Isard, Peter. "Monetary Policy Strategies." *International Monetary Fund Staff Papers*, September 1989, *36*(3), pp. 612-32.

Friedman, Milton. "The Role of Monetary Policy." *American Economic Review*, March 1968, *56*(1), pp. 1-17.

Herrendorf, Berthold and Lockwood, Ben. "Rogoff's Conservative Central Banker Restored." *Journal of Money, Credit, and Banking*, November 1997, Part 1, *29*(4), pp. 476-95.

Holland, A. Steven. "Uncertain Effects of Money and the Link between the Inflation Rate and Inflation Uncertainty." *Economic Inquiry*, January 1993, *31*(1), pp. 39-51.

Jensen, Henrik. "Credibility of Optimal Monetary Delegation." *American Economic Review*, December 1997, *87*(5), pp. 911-20.

Judd, John P. and Scadding, John L. "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature." Journal of *Economic Literature*, September 1982, *20*(3), pp. 993-1023.

King, Mervyn. "Changes in UK Monetary Policy: Rules and Discretion in Practice." *Journal of Monetary Economics*, June 1997, *39*(1), pp. 81-97.

Kydland, Finn E. and Prescott, Edward C. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy*, 1977, *85*(3), pp. 473-92.

Letterie, Wilko. "Better Monetary Control May Decrease the Distortion of stabilization Policy: A Comment." Scandinavian Journal of *Economics*, September 1997, *99*(3), pp. 463-470.

Lohmann, Susanne. "Optimal Precommitment in Monetary Policy: Credibility versus Flexibility." *American Economic Review*, March 1992, *82*(1), pp. 273-86.

McCallum, Bennett T. "Two Fallacies Concerning Central-Bank Independence." *American Economic Review*, May 1995 *(Papers and Proceedings)*, *85*(2), pp. 207-11.

Obstfeld, Maurice. "Destabilizing Effects of Exchange Rate Escape Clauses." *Journal of International Economics*, August 1997, *43*(1-2), pp. 61-77.

Pearce, Douglas and Sobue, Motoshi. "Uncertainty and the Inflation Bias of Monetary Policy." *Economics Letters*, December 1997, *57*(2), pp. 203-7.

Persson, Torsten and Tabellini, Guido. "Designing Institutions for Monetary Stability." *Carnegie-Rochester Conference Series on Public Policy*, December 1993, *39*, pp. 53-84.

Poole, William. "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model." *Quarterly Journal of Economics*, May 1970, *84*(2), pp. 197-216.

Rogoff, Kenneth. "The Optimal Degree of Commitment to an Intermediate Target." *Quarterly Journal of Economics*, November 1985, *100*(4), pp. 1169-90.

Sargent, Thomas J. "Discussion of 'Policy Rules for Open Economies' by Laurence Ball." Mimeo, University of Chicago, April 1998.

Svensson, Lars E. O. "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets." *European Economic Review*, June 1997a, *41*(6), pp. 1111-46.

________. "Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts." *American Economic Review*, March 1997b, *87*(1), pp. 98-114.

Swank, Otto. "Better Monetary Control May Increase the Inflationary Bias of Policy." *Scandinavian Journal of Economics*, 1994, *96*(1), pp. 125-31.

Taylor, John B. "On the Relation between the Variability of Inflation and the Average Inflation Rate." *Carnegie-Rochester Conference Series on Public Policy*, Autumn 1981, *15*, pp. 57-86.

Waller, Christopher J. and Walsh, Carl E. "Central-Bank Independence, Economic Behavior, and Optimal Term Lengths." *American Economic Review*, December 1996, *86*(5), pp. 1139-53.

________. "The Choice of a Conservative Central Banker in a Multisector Economy." *American Economic Review*, September 1992, *82*(4), pp. 1006-12.

Walsh, Carl E. "Optimal Contracts for Independent Central Bankers." *American Economic Review*, March 1995, *85*(1), pp. 150-67.

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