On Discretion versus Commitment and the Role of the Direct Exchange Rate Channel in a Forward-Looking Open Economy Model.

By

Alfred V. Guender*

Department of Economics
University of Canterbury
Christchurch, New Zealand

ABSTRACT

Irrespective of whether discretion or commitment to a binding rule guides the conduct of monetary policy, the existence of a direct exchange rate channel in the Phillips Curve causes the behavior of the key economic variables in the open economy to be dramatically different from that in the closed economy. In the open economy, the policymaker can no longer perfectly stabilize real output and the rate of inflation in the face of IS and UIP shocks as well as shocks to foreign inflation. If the exchange rate channel in the Phillips Curve is operative, then in the open economy the policymaker faces an output-inflation tradeoff that differs substantially from its counterpart in the closed economy.

Our analysis of the conduct of monetary policy reveals that the stabilization bias under discretion is weaker in the open economy relative to the closed economy. In the open economy, a "less conservative central banker", one that attaches a smaller weight to the variance of inflation in the loss function, can be appointed to replicate the behavior of real output that eventuates under optimal policy.

Evaluating the social loss function under discretion and commitment, we find that the existence of a direct exchange rate channel in the Phillips Curve mitigates the pronounced differences between the two strategies that exist in case of high persistence in the stochastic shocks.

JEL Classification Codes: E52, F41

*Mailing Address (through December 15th, 2002): Research Department, Bank of Finland, P.O. Box 160, FIN-00101 Helsinki, Finland.
Mailing Address (after December 15th, 2002): Department of Economics, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. E-mail: a.guender@econ.canterbury.ac.nz
Phone: (64)-3-364-2519. Fax: (64)-3-364-2635.

The results reported in this paper are based on research undertaken while the author was visiting the Center for Pacific Baisin Studies at the Federal Reserve Bank of San Francisco. The author also gratefully acknowledges the support offered by the Bank of Finland where the paper was completed. I thank both institutions for their hospitality. I also wish to thank Richard Dennis for stimulating conversations about this topic.

Introduction.

In the open economy the exchange rate is an important factor in the design of monetary policy. The nominal exchange rate may serve as the underlying objective of monetary policy in the short-to-medium term in its capacity as an intermediate target. The real exchange rate is of concern to policymakers not least because of its importance in determining the competitiveness of domestic goods in global markets. Clarida, Gali, and Gertler (2001) emphasize the role of the real exchange rate as the driving force behind the expenditure switching effect in their open economy model. Their model is by-and-large an extension of the closed-economy New Keynesian framework to the open economy, albeit one that allows only a circumscribed role for the real exchange rate in the transmission of monetary policy effects.[1] That the real exchange rate can play a much more pervasive role has recently been documented by Ball (1999), Froyen and Guender (2000), Guender (2001), McCallum and Nelson (1999), Svensson (2000), and Walsh (1999).[2,3] All of these contributions share the common characteristic that the real exchange rate directly affects behavior on the production side of the economy.[4]

This paper underscores the importance of the direct exchange rate channel in the transmission of monetary policy effects in the open economy. We show that the stabilizing properties of discretionary and optimal policymaking in the face of demand-side disturbances diminish dramatically if this direct exchange rate channel is present in the Phillips Curve. In addition, we illustrate that the optimal relationship that

1 For a detailed exposition of the closed economy New Keynesian framework, see their survey article (1999).
2 This list is by no means exhaustive. Early contributions that highlight the real exchange rate effects on aggregate supply are by Marston (1985) and Turnovsky (1983).
3 While writing this paper, I became aware of the existence of an unpublished paper by Walsh (1999). He examines the conduct of monetary policy in the open economy from a similar perspective after extending Calvo's (1983) staggered price setting model to the open economy.
4 Employing a backward-looking framework, Ball (1999) motivates the direct real exchange rate effect on the rate of inflation by assuming that foreign producers care only about goods prices expressed in *their* home currency. McCallum and Nelson (1999) and Froyen and Guender (2000) assume that a foreign resource input enters as an intermediate input in production. Guender (2001) extends Rotemberg's (1982) sticky price model to the open economy where domestic producers take their optimal price to be equal to the domestic currency price of the competing foreign good. Walsh (1999) introduces a real exchange rate channel by assuming that real wage demands are based on the CPI.

characterizes real output and the rate of inflation in the open economy depends on all structural parameters of the model and the policymaker's preferences. Persistence in the stochastic disturbances figures also in the determination of the optimality condition under commitment. Our analysis also reveals that the output-inflation tradeoff is more favorable under commitment than under discretion in part because of the existence of the direct exchange rate channel. Moreover, the stabilization bias inherent in discretionary policymaking is found to be lower in our open economy framework relative to the standard closed economy framework. As a consequence, a less "conservative central banker" can be entrusted with the task of running the central bank. Towards the end of the paper, we investigate the effects of varying the degree of persistence in the stochastic disturbances and the size of the direct exchange rate effect in the Phillips Curve on the attractiveness of discretionary policymaking versus commitment. High persistence in the stochastic shocks combined with a weak or non-existent direct exchange rate channel in the Phillips Curve detract from the appeal of conducting monetary policy with discretion.

The organization of the paper is as follows. In Section II.A we lay out the building blocks of the model while in Section II.B we present a brief description of the policymaker's preferences. Section III and Section IV analyze the conduct of monetary policy under discretion and commitment. The issue of appointing a conservative central banker is taken up in Section V. In Section VI we parameterize the model to evaluate the performance of policymaking under discretion and commitment. This exercise relies on a numerical evaluation of loss functions. Concluding remarks appear in Section VII.

II.A. The Model.

This section presents a model of a small open economy. Three equations make up the model. All variables with the exception of the nominal interest rate are expressed in logarithms. All parameters are positive.

$$p_t = E_t p_{t+1} + a y_t + b q_t + u_t \tag{1}$$

$$y_t = E_t y_{t+1} - a_1 \left(R_t - E_t p_{t+1} \right) + a_2 q_t + v_t \tag{2}$$

$$R_t - E_t p_{t+1} = R_t^f - E_t p_{t+1}^f + E_t q_{t+1} - q_t + e_t \tag{3}$$

where:

y_t = the real output gap.

π_t = domestic rate of inflation at time t measured as $p_t - p_{t-1}$.

$E_t\pi_{t+1}$ = the expectation of π_{t+1} formed at time *t*.

$E_t\pi^f_{t+1}$ = the expectation formed at time *t* of the foreign rate of inflation for period *t+1*

R_t = the domestic nominal interest rate at time *t*.

R^f_t = the foreign nominal interest rate at time *t*.

q_t = the real exchange rate defined as $s_t + p^f_t - p_t$ where s_t is the nominal exchange rate (domestic currency per unit of foreign currency), p^f_t is the foreign price level, and p_t is the domestic price level.

$E_t q_{t+1}$ = the expectation dated t of the real exchange rate for period *t+1*.

u_t, v_t, and ε_t are stochastic disturbances**.**

The first two relations incorporate the forward-looking behavior typical of the New Keynesian framework. Equation (1) represents the forward-looking Phillips curve relation for the open economy. In this economy real output is produced by monopolistically competitive firms. These firms set the price of output in order to minimize a cost function that takes into account the existence of menu costs and the cost of charging a price different from the optimal price. Apart from the standard excess demand effect, the open economy Phillips Curve also features a direct real exchange rate effect on domestic inflation.[5] Equation (2) defines an open economy IS relation - output demanded depends on the expected real interest rate and the real exchange rate.[6] Equation

5 The rationale behind this is that a depreciation causes the domestic currency price of the foreign good, ($p^f_t + s_t$), to increase. The increase in the exchange rate forces up the optimal price, which, ceteris paribus, induces firms to raise the price of their output so as to minimize the deviation between the optimal price and the actual price charged. At the aggregate level the increase in the domestic price level causes the rate of inflation to rise. Thus we observe the positive link between the exchange rate and the rate of inflation. For a complete derivation of the open economy Phillips Curve, see Guender (2001).

6 This is a simplified version of the IS relation for the open economy in McCallum and Nelson (1997) or Guender (2001) that is derived from first principles. The IS relation presented in Guender (2001) differs from the one above in that the expectation of the real exchange rate for period t+1, the current foreign output gap as well as the expectation of the foreign output gap for period t+1 enter. The simplified IS

(3) is the uncovered interest rate parity condition (UIP), expressed in real terms, where e_t can be thought of as a time-varying risk premium.

II.B. The Preferences of the Policymaker.

The policymaker's preferences extend over the variability of the real output gap and the domestic rate of inflation, respectively. The explicit objective function that he attempts to minimize is given by

$$\frac{1}{2}E_t[\sum_{i=0}^{\infty} b^{i}[y_{t+i}^{2} + mp_{t+i}^{2}]] \qquad (4)$$

Equation (4) implies that the policymaker's sole concern rests with real output and inflation variability. Fluctuations in the real exchange rate do not enter explicitly the loss function. The reason for the omission is that changes in the real exchange rate are reflected in changes in the output gap.[7,8]

III. Policy Making Under Discretion.

To set the stage for illustrating how discretionary policymaking in the open economy is carried out, it is helpful at the outset to reduce the dimension of the optimization problem to one involving only one constraint. A few simple steps need to be taken. First, we solve the UIP condition for the real exchange rate and substitute it into both the IS equation and the Phillips curve relation. Next, we solve the IS relation for the expected real rate of interest ($R_t - E_t p_{t+1}$). Following this, we insert the expression for expected real rate of interest into the Phillips curve relation. The following expression results:

---

relation suffices for the purpose of the current paper. There is no LM relation as the policymaker uses the nominal interest rate as the policy instrument.

7 This is evident once the UIP condition is solved for R_t and the resulting expression is inserted into the IS curve. For a similar view on why the loss function contains only real output and the domestic rate of inflation, see Clarida, Gali, and Gertler (2001). Adopting equation (4) as the welfare criterion ignores the effects on welfare of changes in the real exchange rate in the open economy framework.

8 The target level for real output is the trend level of output. The target rate for the rate of inflation is assumed to be zero. Woodford (1999a) derives an endogenous loss function based on the utility-maximizing framework. According to this analysis, the policymaker ought to be concerned with the variability of the output gap (and not the level of output) and the stability in the general price level.

$$p_t = (a + \frac{b}{a_1 + a_2}) y_t + E_t p_{t+1} + [\frac{ba_1}{a_1 + a_2}(R_t^f - E_t p_{t+1}^f + E_t q_{t+1} + e_t)] - \frac{b}{a_1 + a_2}(E_t y_{t+1} + v_t) + u_t \quad (5)$$

When setting policy with discretion, the policymaker takes the expectations of the endogenous variables y_t, p_t, q_t and the remaining terms as given.[9] Hence we can rewrite the above as

$$p_t = (a + \frac{b}{a_1 + a_2}) y_t + f_t \quad (6)$$

where

$$f_t = E_t p_{t+1} + [\frac{ba_1}{a_1 + a_2}(R_t^f - E_t p_{t+1}^f + E_t q_{t+1} + e_t)] - \frac{b}{a_1 + a_2}(E_t y_{t+1} + v_t) + u_t \quad (7)$$

Notice further that the objective function can be neatly broken up into two separate components as future values of the endogenous variables are independent of today's policy action:[10]

$$\frac{1}{2}[y_t^2 + mp_t^2] + F_t \quad (8)$$

where $F_t = \frac{1}{2} E_t [\sum_{i=1}^{\infty} b^i (y_{t+i}^2 + mp_{t+i}^2)$

The problem of setting policy under discretion thus reduces to the following simple one-period optimization problem:

$$\underset{y_t, p_t}{Min} \quad \frac{1}{2}[y_t^2 + mp_t^2] + F_t$$

subject to

$$p_t = (a + \frac{b}{a_1 + a_2}) y_t + f_t$$

9 Here we adopt the convention of describing the conduct of discretionary policy along the lines of Clarida, Gali, and Gertler (1999).

Combining the first-order conditions produces a systematic negative relationship between real output and the rate of inflation:

$$y_t = -m(a + \frac{b}{a_1 + a_2})p_t \qquad (9)$$

The coefficient on the rate of inflation indicates the loss of output that the policymaker is prepared to sustain if the rate of inflation exceeds its zero target level.

There are several noteworthy facts about the systematic relationship between real output and the rate of inflation under discretion:

a. If the direct exchange rate channel is absent from the Phillips Curve, i.e. if $b=0$, then the optimal relationship between real output and the rate of inflation is the same for both the open and the closed economy framework. In this case, the coefficient on p_t reduces to $-ma$. If $b > 0$, then the optimality condition depends on *all* parameters of the model, and not only on the parameter on excess demand in the Phillips curve.

b. As long as $b > 0$ the coefficient on the rate of inflation is greater in the open economy than in the closed economy since $m(a + \frac{b}{a_1 + a_2}) > ma$.

c. The greater the size of the two Phillips curve parameters, a and b, the greater the sacrifice in terms of real output that must be made when the rate of inflation exceeds its target. Conversely, the more sensitive real output responds to the exchange rate and the real rate of interest (i.e. the greater a_1 and a_2), the less real output must decrease in case inflation exceeds its target level. Clearly, greater aversion to deviations of the rate of inflation from target (increasing m) also increases the coefficient on p_t.

d. In the closed economy, the inverse relationship between real output and inflation depends critically on the existence of cost-push shocks. In the present open economy framework, this inverse relationship also exists if the excess demand channel is shut off (i.e. in case $a = 0$. Moreover, real output and inflation are inversely related under

10 Future values of y_t and p_t are not affected by policy today as the effect of policy is contemporaneous and

discretionary policy even in the wake of a demand shock. Suppose $v_t > 0$. Real output increases along with the real rate of interest. The increase in the real rate of interest causes the exchange rate to appreciate which in turn causes the rate of inflation to decrease. Thus real output and the rate of inflation move in opposite directions.

To obtain the reduced form equations for the endogenous variables, we combine the optimality condition, Equation (9), with Equation (5). As expectations are formed rationally, we pose putative solutions of the endogenous variables. We can show that the two endogenous variables of interest, the rate of inflation and the output gap, reduce to the expressions that appear in Table 1. The results presented underscore a critical difference between the open- and the closed-economy framework.[11] While in the closed economy framework the rate of inflation and the output gap respond only to the cost-push disturbance, the two endogenous variables respond to all disturbances of the model in the open economy. Demand-side disturbances – foreign or domestic - can no longer be perfectly stabilized because of the existence of the direct exchange rate channel in the Phillips Curve. Any change in the real rate of interest in the wake of a demand disturbance prompts a change in the real exchange rate that directly affects the rate of inflation. The importance of the direct exchange rate channel depends on the size of the structural parameter *b*. Setting *b* to zero restores the perfect stabilization property of monetary policy in the face of demand-side disturbances.

IV. Policymaking Under Commitment.

Commitment implies that the policymaker follows a rule systematically. In view of the fact that the policymaker cares about deviations of inflation from target and

---

the absence of persistence in the endogenous variables.

11 Throughout the analysis the coefficient on r_t^f is identical to that on e_t. For the sake of brevity, we report only the latter.

deviations of the real output gap from its target level, the policy rule focuses on the two target variables.[12] The policy rule takes a simple linear form:

$$qy_t + p_t = 0 \tag{10}$$

One critical difference that sets policy under commitment apart from policy under discretion pertains to the role of expectations in the model. Under discretion, the policymaker acts on the basis of fixed or given expectations as he is unable to manipulate them systematically. In contrast, under commitment, expectations about future values of the rate of inflation, real output, and the real exchange rate are endemic to the system. Indeed, the temporal properties of the stochastic disturbances that impinge upon the economy are very important in determining these expectations. All shocks are assumed to follow an AR(1) process:[13]

$$\begin{aligned}
v_t &= f v_{t-1} + \hat{v}_t & \hat{v}_t &\sim (0, s_{\hat{v}}^2) \\
u_t &= f u_{t-1} + \hat{u}_t & \hat{u}_t &\sim (0, s_{\hat{u}}^2) \\
p_t^f &= f p_{t-1}^f + \hat{p}_t^f & \hat{p}_t^f &\sim (0, s_{\hat{p}^f}^2) \\
e_t &= f e_{t-1} + \hat{e}_t & \hat{e}_t &\sim (0, s_e^2)
\end{aligned} \tag{11}$$

To proceed, we combine Equation (10) with the IS relation, the Phillips Curve, and the UIP condition. To solve out the expectations of the future rate of inflation, real output, and the real exchange rate, we posit putative solutions for the three endogenous variables in line with the minimum state variable approach suggested by McCallum (1983). The solution for y_t appears in Table 2. It is apparent that the coefficients on the stochastic disturbances depend on the parameters of the model, the policy parameter q, and the autoregressive parameter f.

12 Here we will abstract from the notion of conducting monetary policy from a timeless perspective as discussed by Woodford (1999b) and McCallum and Nelson (2000).

13 To simplify things, we assume that the autoregressive parameter is the same for each disturbance. Imposing this condition has the advantage of allowing us to derive an analytical solution to the problem of determining optimal policy under commitment.

Prior to stating the policy objective faced by the policymaker, we rewrite the objective function in a slightly different form. [14]

$$\frac{1}{2}E_t[\sum_{i=0}^{\infty} b^i [y_{t+i}^2 + mp_{t+i}^2]] = (1+mq^2)y_t^2 E_t \sum_{i=0}^{\infty} \frac{b^i y_{t+i}^2}{y_t^2}$$

The next step consists of substituting the reduced form equation for y_t into the objective function. Under commitment the policymaker chooses the policy parameter q so as to minimize the objective function. The objective faced by the policymaker under commitment can be restated as:

$$\underset{q}{Min} \frac{(1+mq^2)[bv_t - (a_1(1-f)+a_2)u_t + a_1 bfp_t^f - a_1 b(e_t + R_t^f)]^2}{[(a_1(1-f)+a_2)(q(1-f)+a)+b(1-f)]^2} L_t \tag{12}$$

where $L_t = E_t \sum_{i=0}^{\infty} \frac{b^i y_{t+i}^2}{y_t^2}$, an expression that does not contain the policy parameter q.

The solution to the minimization problem is given by:

$$q^c = \frac{1-f}{m[a + \frac{b(1-f)}{a_1(1-f)+a_2}]} \tag{13}$$

Substituting Equation (13) back into Equation (10) and rearranging it slightly yields:

$$y_t = -\frac{m}{1-f}[a + \frac{b(1-f)}{a_1(1-f)+a_2}]p_t \tag{14}$$

Equation (14) describes the systematic relationship between real output and the rate of inflation in the open economy under commitment. [15] In addition, Table 3 shows

---

14 Here we follow Clarida, Gertler, and Gali (1999). Also recall that $qy_t = -p_t$.

how the rate of inflation and real output, respectively, responds to the stochastic disturbances of the model under commitment. In the paragraphs to follow, we shall attempt to highlight the he essential differences between policymaking under discretion as opposed to commitment.

The first critical difference pertains to the size of the coefficient on the rate of inflation in the optimality conditions. The coefficient on the rate of inflation is greater under commitment (Equation (14)) than discretion (Equation (9)) for $f > 0$.[16] To see how the improved tradeoff between inflation and real output comes about, we have to reconsider the Phillips Curve for the open economy. Iterating Equation (1) forward yields:

$$p_t = E_t \sum_{i=0}^{\infty} a y_{t+i} + b q_{t+i} + u_{t+i} \qquad (1a)$$

Next, we insert the putative solutions for y_{t+i} and q_{t+i} that underlie the minimum state variables approach:

$$p_t = E_t \sum_{i=0}^{\infty} a(g_{10} v_{t+i} + g_{11} u_{t+i} + g_{12} e_{t+i} + g_{13} p^f_{t+i}) + b(g_{30} v_{t+i} + g_{31} u_{t+i} + g_{32} e_{t+i} + g_{33} p^f_{t+i}) + u_{t+i}$$

(1b)

$$\begin{aligned} p_t &= (ag_{10} + bg_{30})(v_t + f v_t + f^2 v_t + ...) + (ag_{11} + bg_{31} + 1)(u_t + f u_t + f^2 u_t + ...) \\ &+ (ag_{12} + bg_{32})(e_t + f e_t + f^2 e_t + ...) + (ag_{13} + bg_{33})(p^f_t + f p^f_t + f^2 p^f_t + ...) \end{aligned}$$

(1c)

The above reduces to:

$$p_t = \frac{(ag_{10} + bg_{30})}{1-f} v_t + \frac{(ag_{11} + bg_{31} + 1)}{1-f} u_t + \frac{(ag_{12} + bg_{32})}{1-f} e_t + \frac{(ag_{13} + bg_{33})}{1-f} p^f_t \qquad (1d)$$

---

15 The points made earlier about the properties of the optimality condition under discretion in the open as opposed to the closed economy also apply with minor modifications under commitment. For instance, if the exchange rate channel is absent from the Phillips Curve then the optimality condition is the same for both open and closed economies and given by $\frac{ma}{1-f}$.

16 Thus for the output-inflation tradeoff to be different under commitment relative to discretion it is necessary for the disturbances to be autorcorrelated.

Equation (1d) in turn can be rewritten as:

$$p_t = \frac{a}{1-f} y_t + \frac{b}{1-f} q_t + \frac{1}{1-f} u_t \tag{1e}$$

Equation (1e) illustrates the relationship between the rate of inflation, real output, and the real exchange rate under commitment. According to this equation, a decrease in the output gap and an appreciation of the exchange rate are accompanied by a decrease in the rate of inflation. It is instructive to compare the coefficients on the right-hand side of Equation (1e) to their counterparts under discretion:

$$p_t = ay_t + bq_t + E_t\bar{p}_{t+1} + u_t \tag{1g}$$

It becomes immediately apparent that the size of the coefficients on real output and the real exchange rate are greater under commitment than under discretion:

$$\frac{a}{1-f} > a \qquad \text{and} \qquad \frac{b}{1-f} > b \tag{15}$$

The more sensitive response of the rate of inflation under commitment is a direct consequence of the effect of the policy rule on the expectations of the future evolution of *both* real output *and* the real exchange rate.

The second critical difference between policymaking under commitment as opposed to discretion follows directly from the improved output-inflation tradeoff and pertains to the size of the coefficients on the disturbances in the equations for p_t and y_t. Inspection of the coefficients in Tables 1 and 3 reveals that the rate of inflation is less responsive to shocks under commitment than under discretion. While the numerator of each coefficient is the same for both strategies, the denominator is clearly greater in size under commitment, i.e. $C>D$. In contrast, real output is more sensitive to shocks under commitment than under discretion.[17] Thus inflation is closer to target under commitment while the output gap is smaller under discretion. Hence there is a bias towards stabilizing real output under discretion. But how serious is the stabilization bias in the open as opposed to the closed economy? To provide a partial answer to this question, let us compare the response of real output to a cost-push shock in both frameworks.[18] Figure 1 underscores the importance of the real exchange rate channel in reducing the size of the stabilization bias in the open economy. In the case where $b = 0$, which also corresponds to the closed economy framework, the stabilization bias is not only much greater in size but is also more sensitive to the degree of persistence in the stochastic disturbances than in the open economy. As b increases in steps of *0.25* the stabilization bias becomes ever smaller. Irrespective of the size of b, the stabilization bias first rises and then drops off as the degree of persistence in the stochastic disturbances increases.

Taken altogether, the results reported in this section can be summarized as follows. First, the optimal policy parameter in the open economy differs substantially from its counterpart in the closed economy due to the existence of a direct exchange rate channel. Second, the findings suggest that in the open economy the responses of real output and inflation to stochastic disturbances – though more complex and different in size - follow the same pattern under commitment and discretion as in the closed economy.[19] Third, the stabilization bias is smaller in the open compared to the closed economy framework.

V. On the Issue of the Conservative Central Banker.

The closed-economy analysis by Clarida, Gali, and Gertler (1999) contains an intriguing result. They argue that that the rationale for appointing a conservative central banker of the Rogoff (1985) type also holds in a closed economy framework that fits the New Keynesian mold. Indeed, the appointment of a banker who attaches a greater weight

17 The appendix provides a detailed explanation of this result.

18 The comparison focuses on the cost-push disturbance, as it is the only disturbance that affects real output in the closed economy.

19 It should be borne in mind, however, that the autoregressive parameter f has a far more important role to play in the open economy than in the closed economy. This is made evident by $1-f$ being attached not only to the preference parameter of the policymaker but also to structural parameters such as b and a_1.

to inflation variability than society in the objective function and carries out policy with discretion results in outcomes for inflation and real output that are identical to those under commitment.

In the closed economy, the optimality condition under discretion and commitment are given by:

$$ma \qquad \text{and} \qquad \frac{ma}{1-f} \tag{16}$$

Thus if m in the objective function is replaced with $m^* = \dfrac{m}{1-f} > m$, and the policymaker carries out policy with discretion, he will deliver the same solutions for real output and the rate of inflation as under commitment.

This result does not, however, carry over to the open economy framework where the direct exchange rate channel in the Phillips Curve is operative. This can easily be seen by comparing the optimality conditons under commitment and discretion:

$$\begin{array}{cc} \text{Discretion} & \text{Commitment} \\ m[a + \dfrac{b}{a_1 + a_2}] & \dfrac{m}{1-f}[a + \dfrac{b(1-f)}{a_1(1-f) + a_2}] \end{array} \tag{17}$$

Appointing a conservative central banker, one who has a greater aversion to inflation variability (replacing m with m^* and vesting him with discretion, will not suffice to deliver the same output-inflation tradeoff (or induce the same behavior for real output and inflation) as prevails under commitment.

Nevertheless it is possible to induce real output and the rate of inflation to mimic their behavior under commitment if a conservative banker with the appropriate dislike for inflation variability is chosen. This weight is given by:[20]

20 To obtain this result, simply equate the output-inflation tradeoffs under discretion and commitment and solve for m^{CB}. Alternatively, set the denominators of the coefficients of the rate of inflation (or output) on a given shock under both policy regimes equal to each other and solve for m^{CB}.

$$m^{CB} = \frac{m}{1-f}\left[\frac{a + \dfrac{b}{a_1 + \dfrac{a_2}{1-f}}}{a + \dfrac{b}{a_1 + a_2}}\right] \tag{18}$$

As the numerator of the expression within brackets is smaller than the denominator in Equation (18) it follows further that:

$$m < m^{CB} < m^* . \tag{19}$$

Thus, compared to the closed economy, in the open economy, a “less conservative” central banker vested with discretion would do to replicate the behavior of real output and the rate of inflation that prevails under commitment. The existence of the direct exchange rate effect on the rate of inflation in the forward-looking Phillips Curve accounts for the smaller weight on the variance of the rate of inflation in the loss function. Consider the following scenario. Suppose that there is upward pressure on inflation as a result of a cost-push shock or demand-side disturbance. The monetary tightening in response to the inflationary pressure causes the exchange rate to appreciate. This in turn has an immediate mitigating effect on the rate of inflation that complements the indirect effect that the output gap exerts on inflation through the combined interest rate and exchange rate channels. With monetary policy being able to influence the rate of inflation through the exchange rate, the policymaker can afford to accord a smaller weight to the variance of the rate of inflation in the loss function.

VI. The Monetary Policy Strategies in Perspective.

In this section we intend to compare and contrast policy making under discretion and commitment from a somewhat different angle. The role of a “conservative central banker will also be briefly touched on. Our primary objective is to examine the merits of discretion vis-à-vis commitment on the basis of a numerical evaluation of the social loss function. Two parameters, f and b, play a key role in this comparison. The degree of autocorrelation in the disturbances features because it affects the optimality condition under commitment but not under discretion. The sensitivity of inflation to the real exchange rate in the Phillips Curve is accorded a prominent role because it is instrumental in shaping the optimizing behavior of the policymaker in the open economy. In addition, we also investigate the behavior of the constituent parts of the loss function, i.e. we take a close look at the behavior of the variance of the rate of inflation and the variance of real output in isolation under either strategy of monetary policy.

Table 4 provides summary information about the numerical values of the loss functions and the respective variances under discretion (Dis), commitment (Com), and the case of a "conservative central banker "(CB). Inspection of the contents of Table 4 yields several noteworthy observations. First, autocorrelation in the disturbances is necessary to generate differences in social welfare. In case of white noise disturbances the three loss functions are equal. Second, commitment is welfare-improving vis-à-vis discretion for $0 < f < 0.99$ as indicated by the lower score of the loss function under commitment. Third, losses under discretion and commitment are increasing in the degree of persistence in the stochastic disturbances. Fourth, in the absence of firm commitment to optimal policy, the appointment of a "conservative central banker" can successfully replicate the outcome under commitment as the entries of columns two and three are identical. The weight m^{CB} that the "conservative central banker" must attach to the variance of inflation in his loss function is an increasing function of the degree of persistence of the stochastic disturbances. The weights corresponding to the different values of f appear in the last column of the table. Finally, turning attention to the size of fluctuations of the rate of inflation and real output, we find that under discretion the ratio of the variance of the rate of inflation to that of real output is not only greater than its counterpart under commitment (for $f > 0$) but also immune to the degree of autocorrelation in the disturbances.[21] Dividing column six by column five, we find this value to be constant at 2.98. In marked contrast, we find the ratio of the variance of the

21 Recall that under discretion the autoregressive parameter appears only in the denominator of the coefficients in the reduced form equation. But the denominators cancel in the process of calculating the ratio of the variances, thus accounting for the absence of a relationship between the variances of real output and inflation under discretion and the size of f.

rate of inflation to the variance of real output to be extremely sensitive to the degree of autorcorrelation under commitment. The difference in the two ratios is evident in Figure 2. Under commitment the ratio in question declines from a maximum value of 2.98 to a minimum value that is close to zero while the horizontal line marks the constant value of the ratio under discretion.[22]

Figure 3 shows how the ratio of loss functions, *LossDis/LossCom*, changes as the degree of persistence in the disturbances changes. Each of the five relative loss functions is based on a different value for *b*. All relative loss functions are rather flat and tightly bunched around one for low values of f, but they increase steadily and drift apart for $f > 0.5$. This result implies that marked differences between policymaking under commitment as opposed to discretion arise only if there is a rather high degree of autocorrelation in the disturbances and no pronounced response of the rate of inflation to the real exchange rate in the Phillips Curve. It is apparent that relative losses are most pronounced if $b=0$ and f tends towards maximum persistence (*0.99*). For rather high values of f, relative losses are much smaller if a potent exchange rate channel is operative in the Phillips Curve ($b=1$). Closer inspection of Figure 3 also reveals that for medium-size values of f the magnitude of relative losses does not necessarily move in lock-step with the size of *b*. For instance, for $f < 0.6$ relative losses based on $b=0.25$ and indicated by the dotted curve exceed those associated with $b=0$, represented by the solid curve.

Precise calculations of the relative loss functions appear in Table 5A. Any entry greater than one implies that the losses under discretion exceed those under commitment. Taking each column in isolation, we observe that relative losses increase in line with the degree of serial correlation. Taking each row in isolation, we confirm the finding made by visual inspection of Figure 3 that relative losses do not necessarily decrease as the effect of the direct exchange rate channel in the Phillips Curve increases. Moving from left to right, we find that for $f=0.1$ and $f=0.2$ relative losses reach their maximum if $b = 0.5$ while for $0.3 \leq f \leq 0.6$ relative losses reach their maximum if $b = 0.25$. Notice that in

22 Here a slight anomaly ought to be pointed out. Closer inspection of Table 4, in particular columns 8 and 10 reveals that for extremely high values of f like 0.99 the variance of inflation is actually less than for smaller values of f. This is clearly attributable to the particular parameter values chosen for the purpose of the comparisons. If the current parameter values are replaced with those chosen by Leitemo et al. (2002),

the presence of positive persistence in the stochastic disturbances, both the minimum and the maximum value of the relative loss function obtain in the absence of a direct exchange rate effect in the Phillips Curve.

In Table 5B we tabulate *ratios* of the relative loss functions. There are four different ratios. Each ratio has the same denominator - the case where the relative loss function corresponds to $b = 0$ - but a different numerator that depends on a given, strictly positive value for b. Examining each of the four columns, we observe a relationship between the ratios of the relative loss function and f that is initially positive before reaching a maximum and thereafter declining. The boldface numbers in the table represent the maximum values of the respective ratio. Notice that the size of the maximum ratio declines as the size of b increases. There is a clearly recognizable step-function like pattern in Table 5B. The greater the size of b, the less likely it becomes that $\frac{L^{b>0}}{L^{b=0}} > 1$.[23]

Taken altogether, in an economy that features a direct exchange rate channel in the Phillips Curve, the difference between policymaking under discretion and commitment – as measured by the relative social loss function is rather stark. Social losses are greater under discretion especially if there is a large degree of persistence in the stochastic disturbances. The losses mount under discretion because the policymaker ignores the persistence property of the stochastic disturbances, which conveys important information about the future behavior of the endogenous variables, when carrying out the optimization exercise every period.

VII. Conclusion.

The main conclusion that the present paper offers is that the conduct of stabilization policy in the open economy can - but need not - differ markedly from that in the closed economy. Likewise, the inverse optimal relationship between real output and the rate of inflation in the open economy can - but need not – take a different shape from

---

the variance of inflation under commitment increases throughout as f increases. Nevertheless, the essential characteristic of Figure 2, the downward sloping curve, also materializes in this alternative scenario.

the one that prevails in the closed economy. The difference lies in the existence of a direct exchange rate channel in the Phillips Curve.

Irrespective of whether discretion or commitment to a binding rule guides the conduct of monetary policy, the existence of a direct exchange rate channel in the Phillips Curve causes the behavior of the key economic variables in the open economy to be dramatically different from that in the closed economy. In the open economy, the policymaker can no longer perfectly stabilize real output and the rate of inflation in the face of IS and UIP shocks as well as shocks to foreign inflation. If the exchange rate channel in the Phillips Curve is operative, then in the open economy the policymaker faces an output-inflation tradeoff that differs substantially from its counterpart in the closed economy. These findings stand in sharp contrast with the claim that monetary policy in the open economy is isomorphic to the case of monetary policy in the closed economy as recently stated by Clarida, Gali, and Gertler (2001).

Our analysis of the conduct of monetary policy reveals that the stabilization bias under discretion is weaker in the open economy relative to the closed economy. In the open economy, a "less conservative central banker", one that attaches a smaller weight to the variance of inflation in the loss function, can be appointed to replicate the behavior of real output that eventuates under optimal policy.

Scrutinizing the social loss functions under discretion and commitment, we find that pronounced differences between the two strategies exist in case of high persistence in the stochastic shocks coupled with a weak or non-existent direct exchange rate channel in the Phillips Curve.

---

23 Ratios that are greater than one appear in italics.

REFERENCES

Ball, L., 1999. Policy rules for open economies. In: Taylor J.B. (Ed.), Monetary Policy Rules, The University of Chicago Press, Chicago, 129-156.

Calvo, G., 1983. Staggered prices in a utility maximizing framework. Journal of Monetary Economics,12,383-398.

Clarida, R., Gali J., and Gertler M., 1999. The science of monetary policy: A New Keynesian perspective. Journal of Economic Literature, 27, 1661-1707.

--------, Optimal monetary policy in open vs. closed economies: an integrated approach. American Economic Review (2001).

Froyen, R.T. and Guender A.V., 2000. Alternative monetary policy rules for small open economies. Review of International Economics 8 (4), 721-740.

Guender, A.V., 2001. Inflation targeting in the open economy: which rate of inflation to target? Mimeo, University of Canterbury.

Leitemo, K., Roisland O. and Torvik R. 2002. Time inconsistency and the exchange rate channel of monetary policy. Mimeo, Norges Bank.

Marston, R., 1985. Stabilization policies in open economies. In: Jones R.W., Kenen P.B. (Eds.), Handbook of International Economics, vol II, North Holland, Amsterdam, pp. 859-916.

McCallum, B.T., 1983. On non-uniqueness in rational expectations models: an attempt at perspective. Journal of Monetary Economics 11, 139-168.

--------, and Nelson E., 1999. Nominal income targeting in an open-economy optimizing model. Journal of Monetary Economics 43, 553-578.

---------, and Nelson E., 2000. Timeless perspective vs. discretionary monetary policy in forward-looking models. NBER working paper 7915.

Roberts, J., 1995. New Keynesian economics and the Phillips Curve. Journal of Money, Credit, and Banking 27 (4), 975-984.

Rogoff, K., 1985. The optimal degree of commitment to an intermediate monetary target. Quarterly Journal of Economics 100 (4), 1169-1189.

Rotemberg, J., 1982. Sticky prices in the United States. Journal of Political Economy 90, 1187-1211.

Svensson, L. E., 2000. Open-economy inflation targeting. Journal of International Economics 50 (1), 155-183.

Turnovsky, S., 1983. Wage indexation and exchange market intervention in a small open economy. Canadian Journal of Economics 16, 574-92.

Walsh, C., 1999. Monetary policy trade-offs in the open economy. Mimeo, University of California, Santa Cruz.

Woodford, M., 1999(a). Inflation stabilization and welfare. Mimeo.

---------, 1999(b). Optimal monetary policy inertia. NBER working paper 7261.

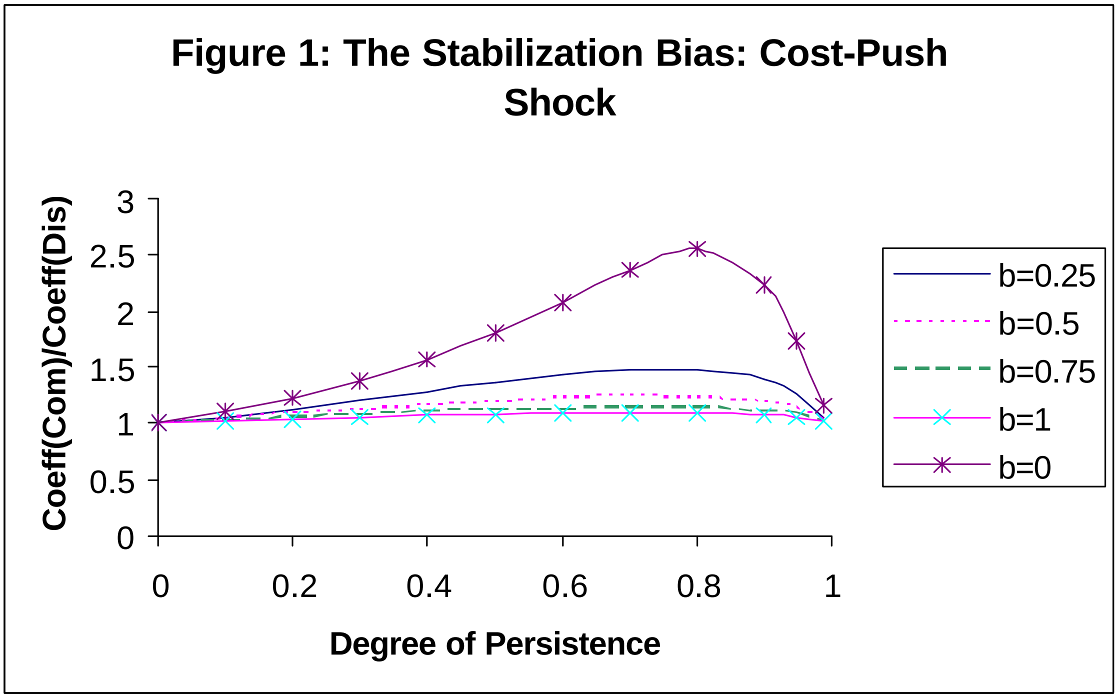
Figure 1: The Stabilization Bias: Cost-Push Shock
Coeff(Com)/Coeff(Dis)
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
Degree of Persistence
b=0.25
b=0.5
b=0.75
b=1
b=0

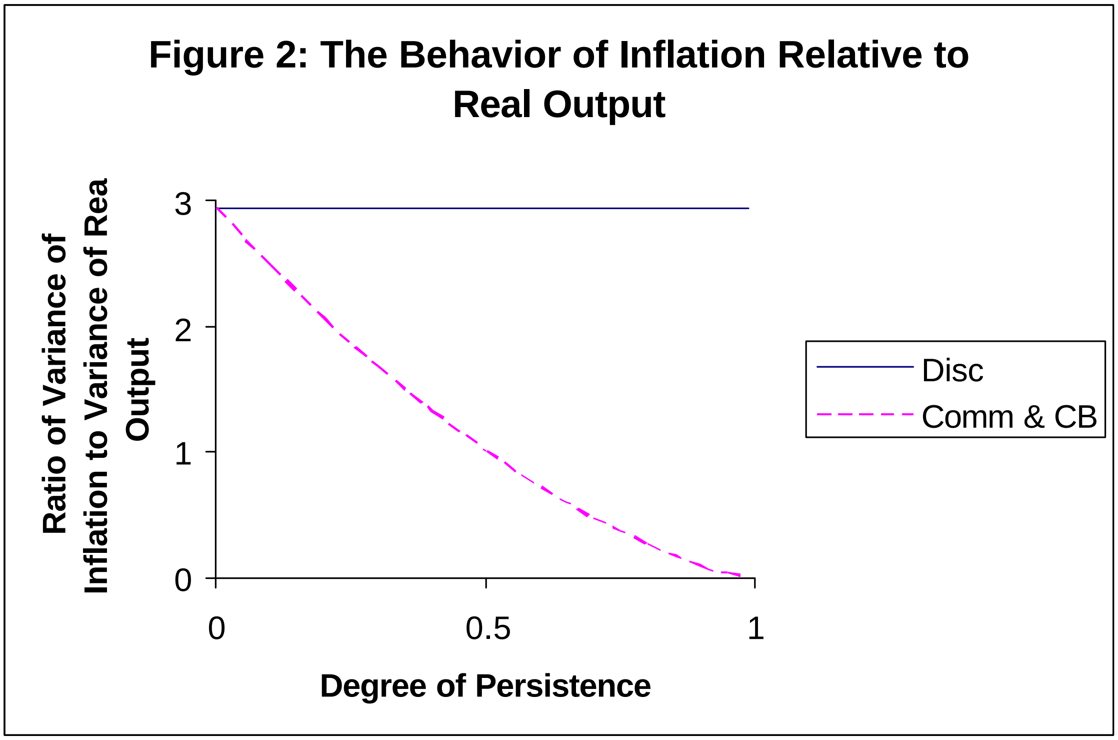
Figure 2: The Behavior of Inflation Relative to Real Output
Ratio of Variance of Inflation to Variance of Rea Output
3
2
1
0
0
0.5
1
Degree of Persistence
Disc
Comm & CB

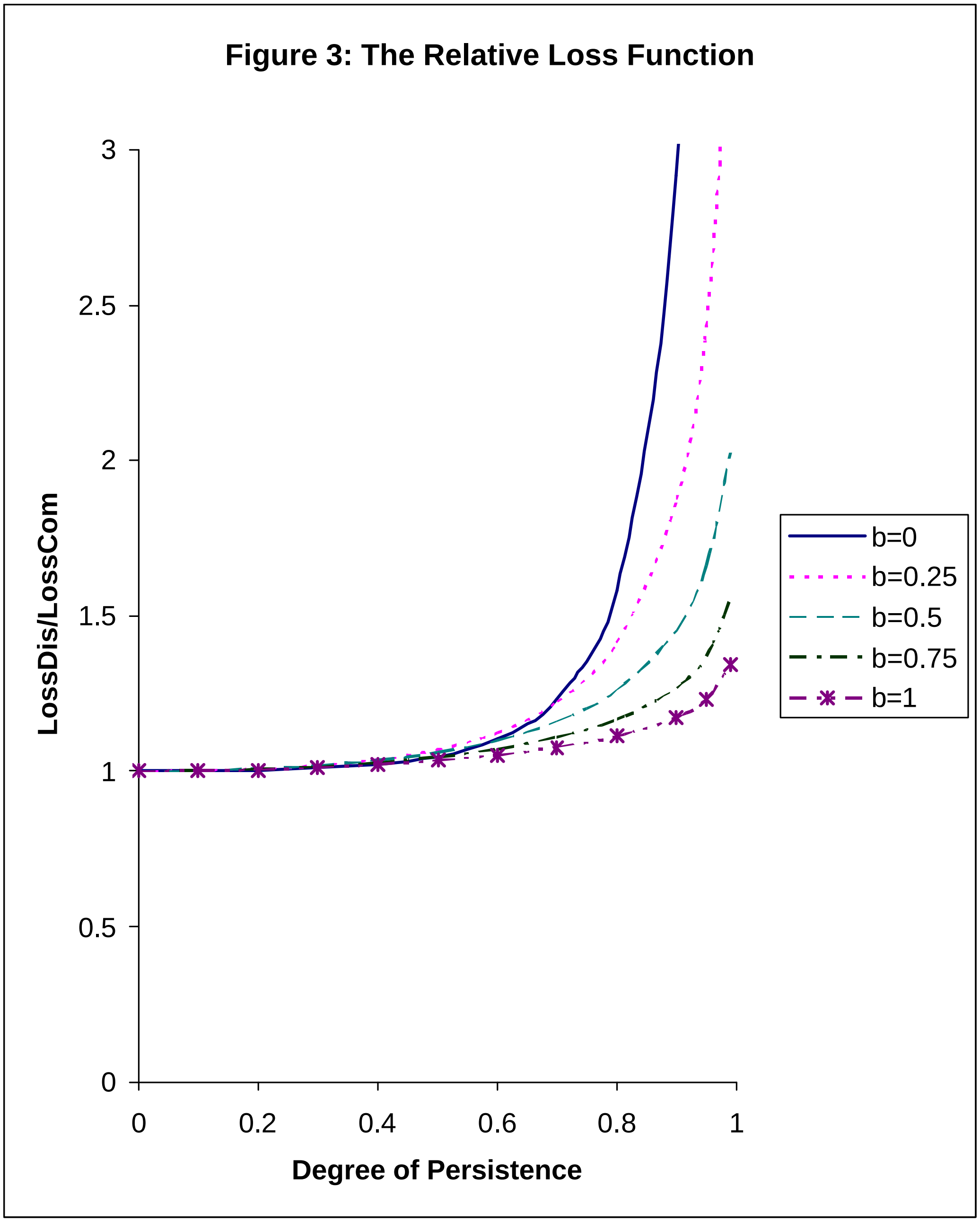
Figure 3: The Relative Loss Function
LossDis/LossCom
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
Degree of Persistence
b=0
b=0.25
b=0.5
b=0.75
b=1

TABLE 1:

The Responses of the Rate of Inflation and the Output Gap to the Disturbances of the Model: The Case of Discretion.

Disturbance	**Rate of Inflation (p_t)**	**Output Gap (y_t)**
IS (v_t)	$-\frac{b}{D}$	$\frac{bm(a+\frac{b}{a_1+a_2})}{D}$
Cost-Push (u_t)	$\frac{a_1(1-f)+a_2}{D}$	$-\frac{(a_1(1-f)+a_2)m(a+\frac{b}{a_1+a_2})}{D}$
UIP (e_t)	$\frac{a_1 b}{D}$	$-\frac{a_1 bm(a+\frac{b}{a_1+a_2})}{D}$
Foreign Inflation (p_t^f)	$-\frac{a_1 bf}{D}$	$\frac{a_1 bfm(a+\frac{b}{a_1+a_2})}{D}$

where $D = bm[(a+\frac{b}{a_1+a_2})(1-f)+\frac{a}{a_1+a_2}((1-f)a_1+a_2)]+(a_1(1-f)+a_2)(1-f+a^2m)$

TABLE 2:

The Reduced Form Equation for Real Output.

Disturbance	**Output Gap (y_t)**
IS (v_t)	$\frac{b}{(a_1(1-f)+a_2)(q(1-f)+a)+b(1-f)}$
Cost-Push (u_t)	$\frac{-(a_1(1-f)+a_2)}{(a_1(1-f)+a_2)(q(1-f)+a)+b(1-f)}$
UIP (e_t)	$\frac{-a_1 b}{(a_1(1-f)+a_2)(q(1-f)+a)+b(1-f)}$
Foreign Inflation (p_t^f)	$\frac{f a_1 b}{(a_1(1-f)+a_2)(q(1-f)+a)+b(1-f)}$

Note: Substituting the equation for y_t into the policy rule yields the reduced form equation for the rate of inflation: $p_t = -q y_t$.

TABLE 3:

Responses of the Rate of Inflation and the Output Gap to the Disturbances of the Model: The Case of Commitment.

Disturbance	**Rate of Inflation (p_t)**	**Output Gap (y_t)**
IS (v_t)	$-\frac{b}{C}$	$\frac{b(\frac{m}{1-f})(a+\frac{b(1-f)}{a_1(1-f)+a_2})}{C}$
Cost-Push (u_t)	$\frac{a_1(1-f)+a_2}{C}$	$-\frac{(a_1(1-f)+a_2)(\frac{m}{1-f})(a+\frac{b(1-f)}{a_1(1-f)+a_2})}{C}$
UIP (e_t)	$\frac{a_1 b}{C}$	$-\frac{a_1 b(\frac{m}{1-f})(a+\frac{b(1-f)}{a_1(1-f)+a_2})}{C}$
Foreign Inflation (p_t^f)	$-\frac{a_1 bf}{C}$	$\frac{a_1 bf(\frac{m}{1-f})(a+\frac{b(1-f)}{a_1(1-f)+a_2})}{C}$

where $C = bm(a+\frac{b(1-f)}{a_1(1-f)+a_2}+a)+((1-f)a_1+a_2)((1-f)+\frac{a^2 m}{1-f})$

TABLE 4: *The Loss Functions and the Variances of the Rate of Inflation and Real Output.*

LossDis	*LossCom*	*LossCB*	*f*	*V(y)Dis*	*V(p)Dis*	*V(y)Com*	*V(p)Com*	*V(y)CB*	*V(p)CB*	m^{CB}
0,212435	0,212435	0,212435	0	0,053934	0,158501	0,053934	0,158501	0,053934	0,158501	1
0,258051	0,257686	0,257686	0,1	0,065516	0,192536	0,074034	0,183652	0,074034	0,183652	1,088
0,326993	0,324868	0,324868	0,2	0,083019	0,243974	0,106244	0,218623	0,106244	0,218623	1,195
0,435529	0,428155	0,428155	0,3	0,110575	0,324954	0,160354	0,267801	0,160354	0,267801	1,327
0,616945	0,595258	0,595258	0,4	0,156634	0,460311	0,256853	0,338405	0,256853	0,338405	1,494
0,946734	0,885417	0,885417	0,5	0,240362	0,706371	0,442708	0,442708	0,442708	0,442708	1,714
1,62208	1,441746	1,441746	0,6	0,411823	1,210256	0,83944	0,602306	0,83944	0,602306	2,024
3,274021	2,675869	2,675869	0,7	0,831228	2,442793	1,820066	0,855803	1,820066	0,855803	2,500
8,688688	6,144074	6,144074	0,8	2,205936	6,482751	4,87945	1,264624	4,87945	1,264624	3,367
40,85878	21,82294	21,82294	0,9	10,37347	30,48531	20,02105	1,801894	20,02105	1,801894	5,714
1572,193	452,9007	452,9007	0,99	399,1579	1173,035	452,2307	0,669991	452,2307	0,669991	44,538

Notes:

a. It is conventional practice to assume that the discount factor in the loss function approaches unity. Following this convention allows us to replace the standard loss function $y_t^2 + mp_t^2$ with the unconditional variances of real output and the rate of inflation. Hence the social loss function is given by:

$Loss = V(y_t) + mV(p_t)$.

In calculating *LossDis, LossCom*, and *LossCB*, we let $m = 1$.

b. The parameter values and the variances of the disturbances upon which the calculations are based are:

$a_1 = 0.5;\ a_2 = a = b = 0.25;\ s_v^2 = s_u^2 = s_e^2 = s_{pf}^2 = 0.25$

Other constellations of parameter values were tried as well. However, they do not affect the results in any meaningful way. For instance, taking the values of the parameters from the study by Leitemo, Roisland and Torvik (2002) produces merely greater numerical values for the loss functions (even though they consider essentially a backward-looking framework, some characteristics of which are incongruent with those of the forward-looking framework).

See footnote 23 of the text for a minor difference concerning the behavior of the rate of inflation under commitment.

TABLE 5A: *The Size of the Relative Loss Functions*.

f	*b=0*	*b=0,25*	*b=0,5*	*b=0,75*	*b=1*
0	1	1	1	1	1
0,1	1,000675	1,001417	1,001559	1,001364	1,001104
0,2	1,003361	1,006543	1,006869	1,005832	1,004636
0,3	1,009675	1,017223	1,017143	1,014088	1,010976
0,4	1,022784	1,036433	1,034102	1,027033	1,020607
0,5	1,049383	1,069252	1,060326	1,045918	1,034178
0,6	1,105186	1,12508	1,09999	1,072653	1,052652
0,7	1,233056	1,223536	1,160765	1,110584	1,077708
0,8	1,580499	1,414157	1,260003	1,167165	1,113148
0,9	2,91716	1,872286	1,45475	1,267539	1,172388
0,95	5,45679	2,434282	1,662599	1,36927	1,231015
0,99	12,65398	3,471386	2,025837	1,551958	1,341341

Note: An entry greater than one implies that the losses under discretion exceed those under commitment (or a conservative central banker).

TABLE 5B: *Ratios of the Relative Loss Functions*.

f	$\frac{L^{b=0,25}}{L^{b=0}}$	$\frac{L^{b=0,5}}{L^{b=0}}$	$\frac{L^{b=0,75}}{L^{b=0}}$	$\frac{L^{b=1}}{L^{b=0}}$
0	1	1	1	1
0,1	*1,000742*	*1,000884*	*1,000689*	*1,000429*
0,2	*1,003172*	*1,003497*	*1,002463*	*1,001271*
0,3	*1,007476*	*1,007396*	***1,004371***	***1,001289***
0,4	*1,013345*	***1,011066***	*1,004154*	0,997872
0,5	***1,018934***	*1,010429*	0,996699	0,985511
0,6	*1,018001*	0,995299	0,970563	0,952466
0,7	0,992279	0,941372	0,900676	0,874014
0,8	0,894754	0,797219	0,738479	0,704302
0,9	0,641818	0,498687	0,434511	0,401894
0,95	0,446101	0,304685	0,25093	0,225593
0,99	0,274332	0,160095	0,122646	0,106002

Note: $\frac{L^{b=x}}{L^{b=0}} = \frac{\frac{LossDis^{b=x}}{LossCom^{b=x}}}{\frac{LossDis^{b=0}}{LossCom^{b=0}}}$ where *x=0,25, 0,5, 0,75, 1*.

Appendix:

The purpose of the appendix is to provide a detailed explanation of how some of the results presented in the main part of the paper were established.24

A. The Response of Inflation and Real Output under Commitment As Opposed to Discretion.

A.1. Inflation

To determine the response of the rate of inflation to cost-push and IS disturbances under commitment relative to discretion, we merely have to compare the denominators of the coefficients of the two shocks.25 That is because the numerators of the coefficients are the same: $a_1(1-f)+a_2$ for the cost-push disturbance and b for the IS disturbance. In what follows below, we break up the denominator into two parts. Doing so brings out the importance of the direct exchange rate channel in the Phillips Curve.

	Commitment	Discretion
First Term	$(a_1(1-f)+a_2)((1-f)+\frac{a^2}{1-f}m)$	$(a_1(1-f)+a_2)((1-f)+a^2m)$
Second Term	$bm(a+(a+\frac{b(1-f)}{a_1(1-f)+a_2}))$	$bm(\frac{a}{a_1+a_2}((1-f)a_1+a_2)+(a+\frac{b}{a_1+a_2})(1-f))$

Comparing the first term, we find that:

$$(a_1(1-f)+a_2)(1-f)+\frac{a^2}{1-f}m)>(a_1(1-f)+a_2)(1-f)+a^2m)$$

as $0<f<1$

For the second term we find that:

$$a>\frac{a}{a_1+a_2}((1-f)a_1+a_2) \text{ and}$$

$$a+\frac{b(1-f)}{a_1(1-f)+a_2}>(a+\frac{b}{a_1+a_2})(1-f).$$

Taken altogether, these results imply that the denominator under commitment is *greater* than the denominator under discretion. In view of the fact that the numerators are equal, this implies further that the rate of inflation is *less* responsive to both cost-push shocks and IS disturbances if the policymaker is bound by commitment to a rule.

---

24 The reader is referred to the results contained in Tables 1 and 2 of the main part of the paper.
25 Notice that UIP and foreign inflation shocks are multiples of the IS shock.

A.2. Real Output

We invoke a similar procedure to determine the response of real output to cost-push and IS disturbances under commitment and discretion. Notice thought that the present comparison is somewhat more complicated as now both the numerators and the denominators of the coefficients on the disturbances for both strategies are different. To facilitate the comparison of the responses under the two competing strategies, we take the following step. We make the numerators of both coefficients equal by dividing the numerators and the denominators of the coefficients on both disturbances by the respective numerator. The resulting expressions thus differ only by the size of their denominators and appear in the table below.

A.2.1.Cost Push Disturbance:

Commitment
$$\frac{-1}{\dfrac{(1-f)^2+a^2m}{m(a+\dfrac{b(1-f)}{a_1(1-f)+a_2})}+\dfrac{(1-f)b}{a_1(1-f)+a_2}+\dfrac{ba}{(a_1+\dfrac{a_2}{1-f})a+b}}$$
Discretion
$$\frac{-1}{\dfrac{(1-f)+a^2m}{m(a+\dfrac{b}{a_1+a_2})}+\dfrac{(1-f)b}{a_1(1-f)+a_2}+\dfrac{ba}{(a_1+a_2)a+b}}$$

Each denominator comprises three terms. They have the following characteristics:

i. the second terms are equal.

ii. it is straightforward to establish that for the third term in the denominators:

$$\frac{ba}{(a_1+\dfrac{a_2}{1-f})a+b}<\frac{ba}{(a_1+a_2)a+b}$$

iii. nothing definite can be said about the first term in the denominators as:

$$(1-f)^2+a^2m<1-f+a^2m \quad \text{and}$$

$$a+\frac{b(1-f)}{a_1(1-f)+a_2} < a+\frac{b}{a_1+a_2}$$

Both the numerator and denominator of the first term are smaller under commitment relative to discretion. As a consequence, it is impossible to show analytically whether the size of the coefficient on the cost-push shock is greater under commitment than under discretion. In view of this ambiguity, we need to draw on values for the structural coefficients and the autoregressive parameter f in order to establish the size of the coefficients. Figure A1 illustrates how the size of the coefficients on the cost-push disturbance in the output equation – as they appear in the above table - varies as the degree of persistence in the disturbances increases from zero to 0.99. The response of real output to a cost-push disturbance is unambiguously greater under commitment than under discretion for all values of $f > 0$.[26]

A.2.2. IS Disturbance

Commitment
$$\frac{1}{\dfrac{(a_1(1-f)+a_2)((1-f)^2+a^2m)}{bm\left(a+\dfrac{b}{a_1+\dfrac{a_2}{1-f}}\right)}+(1-f)+\dfrac{a(a_1(1-f)+a_2)}{\left(a_1+\dfrac{a_2}{1-f}\right)a+b}}$$
Discretion
$$\frac{1}{\dfrac{(a_1(1-f)+a_2)((1-f)+a^2m)}{bm\left(a+\dfrac{b}{a_1+a_2}\right)}+(1-f)+\dfrac{a((1-f)a_1+a_2)}{(a_1+a_2)a+b}}$$

Again each denominator comprises three terms. And once again, we encounter a difficulty in determining analytically whether the size of the coefficient on the IS disturbance is greater under commitment than under discretion.

i. the second terms are equal.
ii. it is straightforward to establish that for the third term in the denominators:

26 Figures A1 and A2 are based on the following parameter values: $a_1 = 0.5,\ a_2 = b = a = 0.25;\ m = 1$. Other parameter values were tried as well but in every case the response of output under commitment exceeded the response under discretion.

$$\frac{a(a_1(1-f)+a_2)}{(a_1+\frac{a_2}{1-f})a+b} < \frac{a(a_1(1-f)+a_2)}{(a_1+a_2)a+b}$$

iii. nothing definite can be said about the first term in the denominators as:

$$(1-f)^2+a^2m < 1-f+a^2m \text{ and}$$

$$a+\frac{b}{a_1+\frac{a_2}{1-f}} < a+\frac{b}{a_1+a_2}$$

To get around this problem, we again assign numerical values to the parameters of the model. Figure A2 depicts the relationship between the size of the cofficient on the IS shock in the output equation under the two policy regimes. Once again for $f > 0$ the response of real output to an IS shock is *greater* under commitment than under discretion.

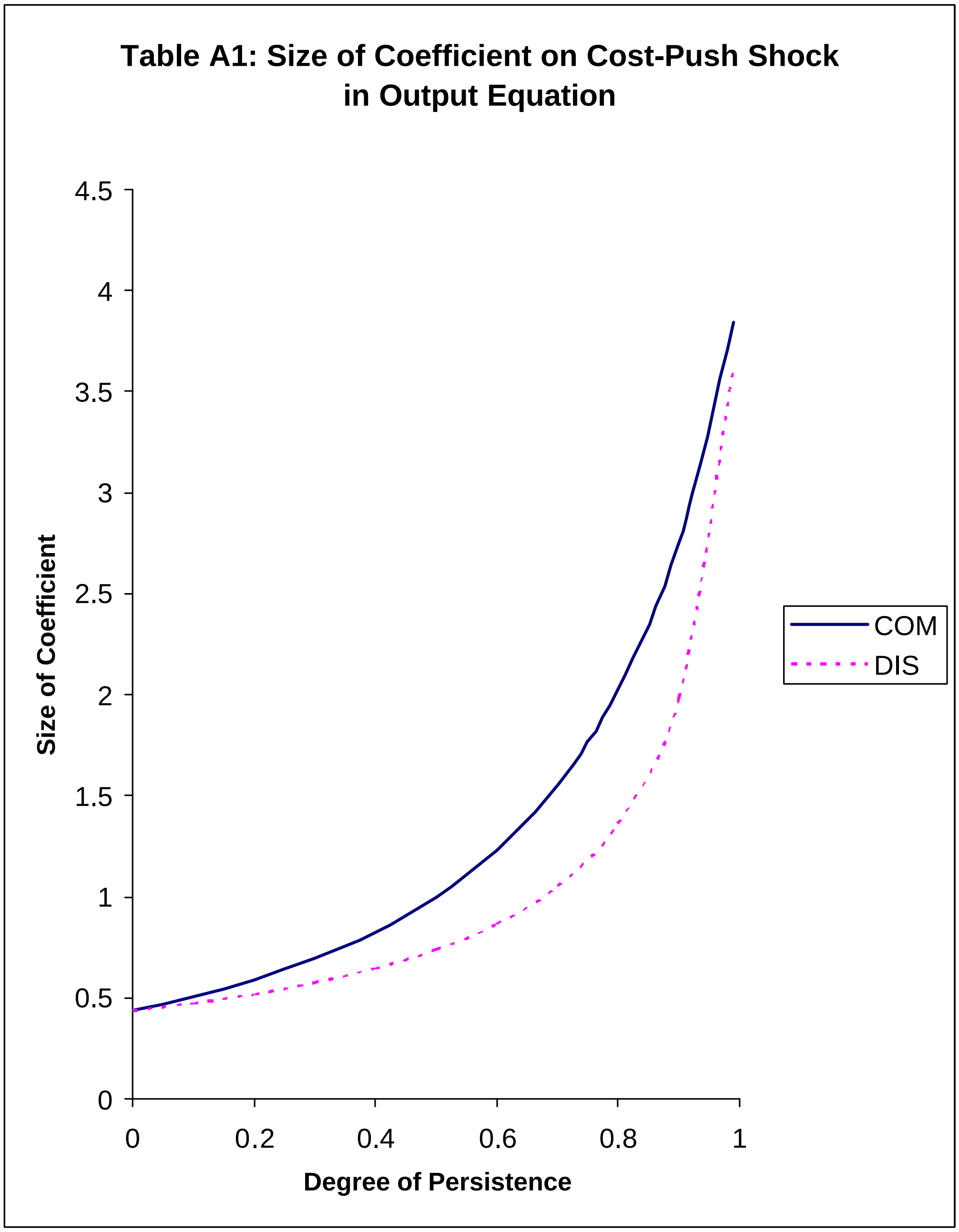
Table A1: Size of Coefficient on Cost-Push Shock in Output Equation
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Size of Coefficient
0
0.2
0.4
0.6
0.8
1
Degree of Persistence
COM
DIS

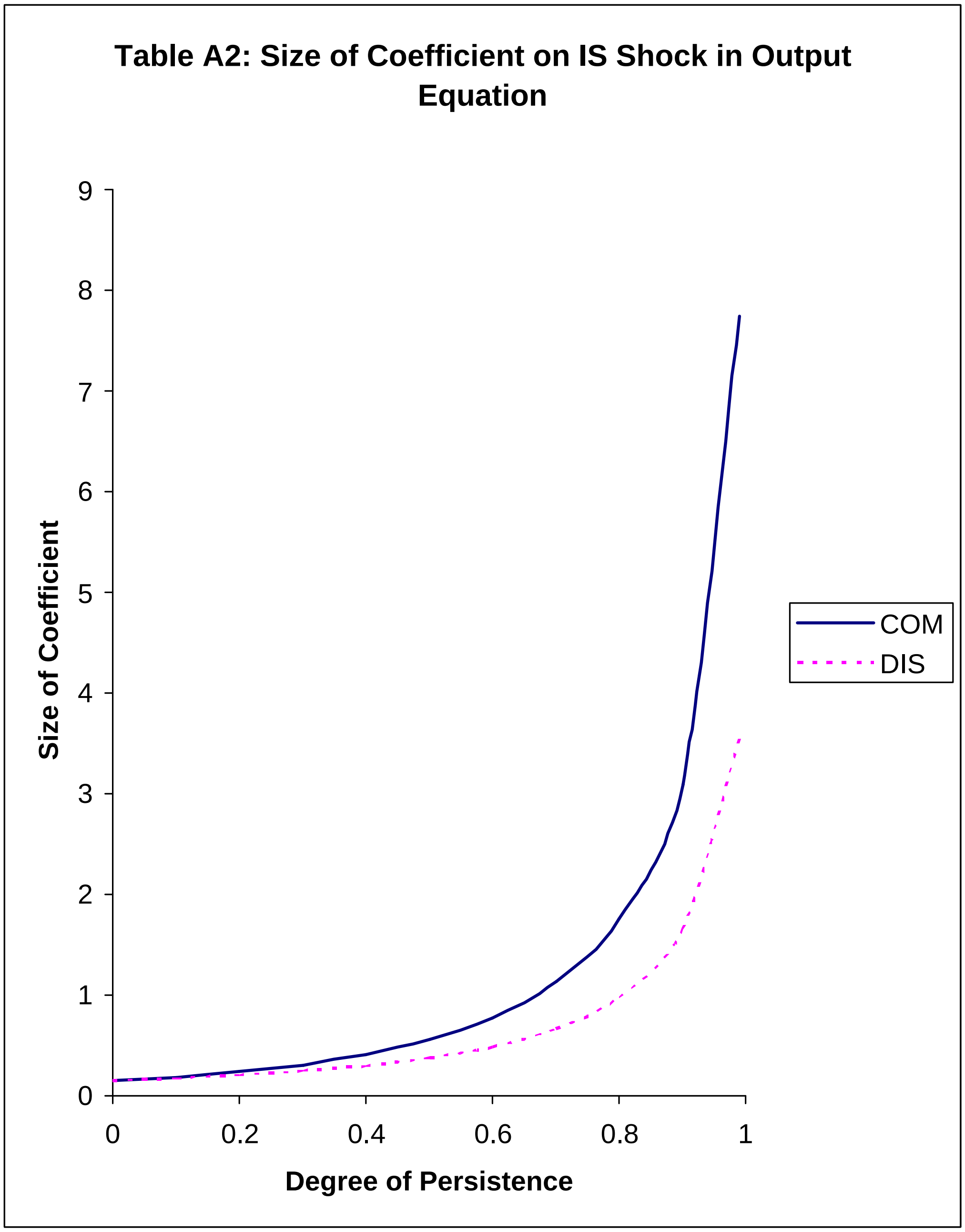
Table A2: Size of Coefficient on IS Shock in Output Equation
Size of Coefficient
Degree of Persistence
0
1
2
3
4
5
6
7
8
9
0
0.2
0.4
0.6
0.8
1
COM
DIS