

The Inflationary Bias in a Model of the Open Economy

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Abstract: In this paper we highlight the importance of aggregate supply effects on the size of the inflationary bias under discretionary policy-making. Using a simple model of an open economy that imports a foreign resource input, we show that under discretion the inflationary bias bears an inverse relationship to the elasticity of output supplied with respect to the real exchange rate. This theoretical finding is consistent with Romer's (1993) empirical results that point to the existence of a negative association between openness and inflation.

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I. Introduction

The circumstances under which an inflationary bias arises in the conduct of monetary policy are well understood. The influential work by Kydland and Prescott (1977) and Barro and Gordon (1983) predicts that the rate of inflation will be higher in a setting where policy-making is guided by discretion rather than rules.

To alleviate the size of the inflationary bias, Rogoff (1985) suggests the appointment of a conservative central banker. Others such as Lohmann (1992) argue that a conservative central banker is not sufficient; the contingency that the central banker can be overruled by the government must be an integral part of the monetary policy process. Walsh (1995) and Persson and Tabellini (1993) propose a state-contingent contract according to which the central banker is punished if the inflation target is exceeded.¹

Most of the literature focuses on a closed economy framework. Two notable exceptions are Romer (1993) and Lane (1997).² Analyzing discretionary policy-making in a simple two-good model, Romer shows that rate of inflation is inversely related to the degree of openness of the economy. He attributes this finding to the fact that the benefits of a monetary surprise in terms of the gain in real output are smaller the more trade-oriented, i.e. open, the economy is. Lane (1997) argues that the existence of nominal price rigidity and imperfect competition in the non-traded goods sector – and not the terms of trade effect suggested by Romer – account for the inverse relationship between inflation and openness.

This paper shows that the inflationary bias under discretion in the conduct of monetary policy is inversely related to the sensitivity with which the supply of real output responds to a change in the real exchange rate. This finding is derived in the context of a simple model where labor and an imported resource (or intermediate input) are combined to produce real output.

II. The Model

The policy-maker minimises the expected value of a loss function which consists of output and price deviations from desired levels:

$$\mathbf{y}_t = (y_t - y^*)^2 + \mathbf{a}(p_t - p^*)^2 \quad (1)$$

¹ Critics like McCallum (1995) argue that the notion that central banks are prone to generate an inflationary bias is seriously flawed.

² See also the comment by Terra (1998) and the response by Romer (1998). Terra argues that Romer's empirical results are driven largely by the behavior of heavily-indebted countries.

p_t is the current and p^* the desired price level. Similarly, y_t is the current level of real output and y^* is the full-employment level of real output. The parameter α reflects the weight placed by the policy-maker on price level stabilization relative to output stabilization.

The demand for goods³ is specified as

$$y_t = \delta(x_t + p_t^f - p_t) + e_t, \quad e_t \sim N(0, \mathbf{s}_e^2) \quad (2)$$

Here x_t is the nominal exchange rate (expressed as domestic currency per unit of foreign currency), p_t^f the foreign price level, δ the parameter measuring the sensitivity of the demand for real output with respect to the real exchange rate, and e_t is a white noise shock. Demand for domestically-produced output is a positive function of the real exchange rate: as the exchange rate depreciates (increases) net exports rise.⁴

The determination of the exchange rate is adopted from Frankel and Chinn (1995) and is modelled as follows:

$$x_t = m_t + z_t - y_t, \quad z_t \sim N(0, \mathbf{s}_z^2) \quad (3)$$

m_t is the level of the domestic money supply and z_t is a white noise shock to the exchange rate.⁵ This formulation replaces the purchasing power parity condition, which numerous empirical studies have shown does not hold in the short run.⁶ The uncovered interest parity condition is also not invoked; McCallum (1995) found it wanting empirically.

Output in the open economy is produced using two factor inputs, labor and a resource or intermediate input which is imported. Following Marston (1985), Benavie and Froyen (1991), we specify an aggregate supply condition in which output supplied bears an inverse relationship to the real exchange rate and the real wage rate.

$$y_t = d - c(w_t - p_t) - q(p_t^f + x_t - p_t) + m_t. \quad (4)$$

where $p_t^f = p^f + f_t$, $f_t \sim N(0, \mathbf{s}_f^2)$, $m_t \sim N(0, \mathbf{s}_m^2)$

³ All variables are in logs unless stated otherwise.

⁴ We are implicitly assuming a high degree of substitutability between domestically-produced goods and imports. A similar specification is employed by Romer (1993). Our specification differs from his in that we omit foreign output, include a supply disturbance, and state the equation in levels.

⁵ Frankel and Chinn argue that “there is no point in specifying an elaborate model of the exchange rate. All the empirical results say that most of the variation in the exchange rate cannot be explained (even ex post, we say nothing of prediction) by measurable macroeconomic variables” (p.324).

⁶ See Rogoff (1996) for a recent survey of issues centered on purchasing power parity.

d , c , and q are positive parameters while μ_t represents a white noise supply-side disturbance. In this economy, the wage level is determined by wage-setters implicitly targeting a level of output \tilde{y} which is less than full-employment output y^* :⁷

$$\frac{d}{dw_t} E_{t-1} (y_t - \tilde{y})^2 = 0 \quad (5)$$

Combining (4) and (5), we obtain the optimized wage level and thus an aggregate supply condition for the open economy:

$$y_t = \tilde{y} + c(p_t - E_{t-1} p_t) + q(p_t - x_t - p_t^f - E_{t-1} [p_t - x_t - p_t^f]) + \mathbf{m} \quad (6)$$

Barring an exogenous supply shock, the level of real output differs from the level targeted by wage-setters only if there exists a disparity between actual and expected values of the price level or the real exchange rate.

The model is closed by specifying the behavior of the monetary authority. In this paper we will consider the scenario where the policy-maker uses discretion in setting monetary policy.

III. Monetary Policy under Discretion

Under discretion the policy-maker attempts to minimize the expected value of the loss function using the money supply as a tool, subject to pre-determined expectations of the price level. Due to the policy-maker's incentive to exploit the given expectations about the price level, we expect an inflationary bias to arise under discretion. The expected loss function under discretionary policy is given by

$$E_{t-1} L_t | Discretion = \frac{\mathbf{a}}{(c\mathbf{d})^2 + (\mathbf{d} + q)^2} \left[q^2 \text{var}(\mathbf{e}) + \mathbf{d}^2 \text{var}(\mathbf{m}) \right] + \left(1 + \frac{(c\mathbf{d})^2}{\mathbf{a}(\mathbf{d} + q)^2} \right) \mathbf{k}^2 \quad (15)$$

$$\mathbf{k} = y^* - \tilde{y}$$

The policy-maker is unable to insulate the economy fully against shocks to either the demand or supply side of the economy. Shocks originating domestically cannot be offset, unlike foreign shocks (exchange rate shocks and foreign price level movements).⁸

⁷ The existence of distortions such as income taxes and unemployment compensation, which impair the supply of labor, or the "insider-outsider" problem are possible explanations for the wedge between the level of employment sought by wage setters in contract negotiations and the socially desirable level of employment that appears in the loss function. Hence $\tilde{y} < y^*$.

Notice that the economy would be protected from domestic demand-side disturbances if there were no real exchange rate effect on aggregate supply (i.e. $q = 0$). In this particular case neither the level of output nor the price level would be displaced and the economy would be perfectly stabilized.

The inflationary bias is the coefficient on the κ^2 term. In sharp contrast to the case of precommitment, where this coefficient is invariably fixed at 1, under discretion the size of the coefficient is greater than 1 and depends on the parameters of the model economy. The inflationary bias is greater:

- a) the higher is the reward, in terms of output supply, of an unexpected price hike (the greater c);
- b) the smaller is the emphasis on price stability in the loss function; (the smaller α)
or
- c) the smaller is the effect of the exchange rate on aggregate supply (the lower q).

The first two effects are well known and have been discussed widely in the literature. The third effect has been discussed formally in the literature but usually in a different context.⁹ In our model this last effect occurs for the following reason. While an unexpected increase in the money supply will lower the real wage rate, thus boosting output supplied, the concomitant depreciation of the real exchange rate will increase the cost of the imported factor of production, and hence impart a depressing effect on output supplied. Thus the total benefit in terms of the gain in real output is reduced. Of great importance is the size of the coefficient q . Economies where output supplied reacts firmly to real exchange rate movements should exhibit, *ceteris paribus*, a *smaller* inflationary bias than countries where output supplied is less sensitive to changes in the real exchange rate.

In a similar vein, the size of c and q affect the size of the coefficients on the variances of shocks that perturb the goods market. As the magnitude of q increases, the impact of disturbances arising on the demand side in the goods market increases while the effect of supply-side shocks decreases. An increase in the size of c tends to reduce the effects of both disturbances but serves to enhance the magnitude of the inflationary bias.

⁸ This property of the model is clearly a result of the simple process governing the behavior of the exchange rate. In a more elaborate model, one could easily show that shocks originating abroad would affect the level of real output and the price level under discretion.

⁹ See Romer (1993) and Lane (1997).

Finally, notice that an increase in α causes the effects of the variances to become more pronounced.

IV. Conclusion

In this paper we highlight the importance of aggregate supply effects on the size of the inflationary bias under discretionary policy-making. Using a simple model of an open economy that imports a foreign resource input, we show that under discretion the inflationary bias bears an inverse relationship to the elasticity of output supplied with respect to the real exchange rate. This theoretical finding is consistent with Romer's (1993) empirical results that point to the existence of a negative association between openness and inflation.

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