MONETARY VERSUS REAL EXCHANGE RATE TARGETS WHEN CAPITAL MOBILITY IS LIMITED

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Latest Revision: November 1985

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*I would like to thank Jacob Frenkel and especially Rudi Dornbusch for their helpful comments.

1. Introduction

Many developing and newly industrialized countries (henceforth DCs and NICs) have tried to stabilize domestic output by following the policy of maintaining the real exchange rate, often through the adoption of mechanical PPP exchange rate rules; it has been traditionally argued that a fixed real exchange rate would insulate the tradeable sector from transitory domestic and foreign disturbances even though such a policy would increase the variability of the price level.

In a recent article, Dornbusch (1983) analyzes the optimality of PPP rules in an open economy with zero capital mobility, in which, therefore, the monetary authorities can peg the nominal exchange rate at any level regardless of the monetary policy being pursued. He shows that, contrary to the traditional view, an indexation of the exchange rate will increase both output and price variability if exchange rate movements have a large impact on domestic costs, if aggregate demand is inelastic with respect to real exchange rate changes and if wage disturbances tend to persist--three conditions indeed prevailing in those countries that have been more prone to fix the real exchange rate. His analysis indicates that a mix of a fixed nominal exchange rate and a wage-accommodating monetary policy would be superior to a PPP rule in order to achieve macroeconomic stability, which is defined as a function of price and output variability around their steady state levels.

In this paper, I re-examine the optimal mix of monetary and exchange rate policies when there is limited capital mobility, that is, when monetary authorities cannot pursue independent exchange rate and monetary targets so that the choice of a pegged exchange rate becomes the choice of a monetary policy (Mussa, 1976 and Frenkel, 1983).[1] I show that if the authorities try to follow a PPP rule, and the exchange rate is endogenously determined by money market equilibrium, the traditional view still applies, so that the authorities will face a trade-off between output and price stability around their steady state levels.[2]

The case of limited capital mobility is the most relevant for DCs and NICs where, notwithstanding the forbidding controls on capital flows, the private sector have always succeeded in moving substantial amounts of financial resources across national borders.[3] In Table 1, I report estimates of the implicit private capital outflows in 1981 and 1982 for a group of NICs and compare them to the stock of official reserves at the beginning of those two years. The table clearly indicates that, despite capital controls, the private sector can rapidly deplete official reserves if the authorities try to peg the exchange rate at a level that is inconsistent with market expectations.

2. The Model

The real sector of the economy is described by equations (1) through (3), which are the same as in Dornbusch (1983):

$$y = a(m - p) + b(e - p) \qquad a, b > 0 \tag{1}$$

$$p = (\phi/2)(x + x_{-1}) + (1 - \phi)e \tag{2}$$

$$x = \Psi x_{-1} + (1 - \Psi)\tilde{x}_{+1} + \gamma\left[\Psi\tilde{y} + (1 - \Psi)\tilde{y}_{+1}\right] + u\,, \qquad \Psi, \gamma \geq 0 \tag{3}$$

where 'y' is real output; 'm' is the stock of money; 'e' is the exchange rate; 'p' is the price of domestic output; 'x' is the level of nominal wages; 'u' is the unexpected (at the beginning of the contractual period) change in wages; a ~ indicates the conditional expectation of a variable at the end of the previous period; the time subscript is omitted; and all variables are expressed in logarithms as well as in deviation from their trend values.

Equation (1) is a semi-reduced form for the deviations of output from the trend; monetary impulses are transmitted to the real sector through the real cash balance effect while real interest rates do not play any role given that DCs and NICs typically lack developed financial markets; equations (2) and (3)--the latter is taken from Taylor (1979)--capture the impact of exchange rate changes on the domestic price level and the persistence of wage shocks, respectively.

The money market is characterized by a money supply reaction function and a money demand:

$$m^s = -\theta(e - p) \qquad \theta \geq 0, \qquad \eta \leq 1 \tag{4}$$

$$m^d = p + \delta(\tilde{x}_{+1} - x) \qquad \delta \leq 0 \tag{5}$$

$$m^s = m^d . \tag{6}$$

The reaction function (4) shows that monetary authorities may change the money stock when the real exchange rate deviates from its steady state level. Although the authorities cannot, in general, peg the real exchange rate, they can smooth its fluctuations around its long-run equilibrium level.[4] The demand for money is homogeneous with respect to the price level; it is a function of permanent income, which is set equal to the steady state level of output; and it is inversely related to the expected rate of change of wages, given that these changes are the only source of disturbance to both price level and exchange rate in the model.[5] This specification of the money demand, in addition to being conventional, maintains the solution of the model as close as possible to that of Dornbusch (1983) thus making the two models comparable.[6]

Equations 2, 4, 5 and 6 determine the equilibrium values of the exchange rate, the price level and the stock of money as functions of $\tilde{x}_{+1}$, x and x_{-1}. Substituting these values into equation (1), the level of output that is consistent with money market equilibrium is obtained, or

$$y = Z_1\tilde{x}_{+1} + Z_2x + Z_3x_{-1} \tag{7}$$

where

$$Z_1 = \delta(aQ - b\phi)/Q$$

$$Z_2 = \left[b\phi\left(2(\delta + \eta) - 1\right) - 2\delta aQ\right]/2Q$$

$$Z_3 = -b\phi/2Q$$

$$Q = (1 - \phi) + \theta\phi \ .$$

Taking conditional expectations in (7) and substituting the result into (3), one obtains the final expression for wages:

$$\begin{aligned}&\left[\gamma(1 - \psi)Z_1\right]\tilde{x}_{+2} + \left[(1 - \psi) + \gamma\psi Z_1 + \gamma(1 - \psi)Z_2\right]\tilde{x}_{+1} - \\ &- \left[1 - \gamma\psi Z_2 - \eta(1 - \psi)Z_3\right]\tilde{x} + \left[\psi + \gamma\psi Z_3\right]\tilde{x}_{-1} = 0\end{aligned} \tag{8}$$

which is a third order difference equation. The solution of the equation involves the non-trivial problem of expressing the three roots as functions of the model parameters, and, therefore, I have to resort to numerical solutions. For all the parameter values considered in the simulations, the numerical solutions have always three real roots but only one of them, ρ, is lower than one. By imposing stability conditions, the solution of (8) thus becomes

$$x = \rho x_{-1} + u \ . \tag{9}$$

Using (9) into (7), output can be expressed as an ARMA(1, 1)[7]

$$y = \rho y_{-1} + Z_2 u + (Z_3 + Z_1 \rho^2) u_{-1} \; . \tag{10}$$

Expression (10) can be used to calculate the relationship between the output variance, σ_y^2, and the variance of the wage disturbance σ_u^2, or:

$$\sigma_y^2 = \left[Z_2^2 + 2Z_2\rho(Z_3 + Z_1\rho^2) + (Z_3 + Z_1\rho^2)^2\right]/(1 - \rho^2)\sigma_u^2 \; . \tag{11}$$

The variance of the price level σ_p^2 can be calculated in a similar way:

$$\sigma_p^2 = (H^2 + 2H\rho M + M^2)/(1 - \rho^2)\sigma_u^2 \tag{12}$$

where

$$H = \left[2(1 - \phi)(\delta + \eta) + \theta\phi\right]/2Q$$

$$M = \left[\phi\theta - 2\rho^2 - 2\delta\rho^2(1 - \phi)\right]/2Q \; .$$

3. Numerical Simulations

In Table 2, I present the results of three simulation exercises in which the expressions (11) and (12) are evaluated for different values of the policy parameter θ. In the first simulation, I set the values of the output equation 'a' and 'b' equal to 1 and .5, respectively, which are upper bounds of the typical parameter estimates of equation (1) for DCs and NICs (Edwards, 1983). I also assume that the money demand elasticity with respect to inflationary expectations is -.2; there are not many good estimates of this elasticity for DCs and NICs, but it is widely believed that, in these countries, money demand is more sensitive to inflationary expectations than in industrialized countries, where the elasticity is generally found to be approximately -.05 (for example, see the survey by Judd and Scadding, 1982). The table indicates that an increase in the degree exchange rate indexation pursued by the authorities, that is, an increase in θ, raises the price level variability and wage persistence but stabilizes output. The tradeoff between output and price stability occurs because a positive wage shock, for example, tends to appreciate the exchange rate for any given stock of money, providing that the impact of expectations on money demand is not too strong. If the authorities pursue a real exchange rate, they will be forced to intervene in foreign exchange markets, thereby expanding the money supply; on the one hand, the expansion will stabilize real cash balances and, consequently, output but, on the other hand, it will increase wage persistence and thus the variance of the price level.

In the second simulation, I increase the value of 'a' to 2 so that the parameter values are the same as in Dornbusch (1983) and the two models become strictly comparable.[8] The table shows that when the exchange rate is endogenous with respect to the money stock, Dornbusch's results are reversed and greater exchange rate indexation does not destabilize output. The reason is that, in his model, the level of the money stock is independent of the exchange rate, so that increasing exchange rate indexation in the face of wage disturbances implies increasingly large changes in real cash balances. Because output mainly depends on real cash balances in this numerical simulation, indexation destabilizes output.

If the money demand elasticity is extremely high, however, a real exchange rule for monetary policy can be destabilizing even in this model. For example, a positive wage shock may create an excess supply of money, instead of an excess demand as in the first simulation, if the shock is an indication that there will be more inflation in the periods ahead and if money demand is extremely elastic to expectations. This possibility is illustrated by the third simulation, in which δ takes the value of $-.6$. Although this value is outside the range of existing empirical estimates, the simulation points to the crucial role of money demand elasticity in the determination of the optimal monetary-exchange rate policy mix.

4. Conclusions

Policy recommendations cannot be made without knowing the relative weights of output and price variabilities in the social welfare function. Nonetheless, it is possible to conclude that monetary policy should try to maintain the real exchange in a small open economy with limited capital mobility if the authorities' main concern is output variability; such a policy, however, could be destabilizing if the money demand is extremely elastic with respect to inflationary expectations.

Footnotes

[1]If sterilized intervention were effective, then monetary policy would be independent of exchange rate policy. In practice, however, sterilized intervention is not feasible in DCs and NICs because they lack well developed government security markets; in addition, there is scant evidence that sterilized intervention is an effective policy even in industrialized countries (Rogoff, 1984).

[2]Bhandari (1982) and Penati (1985) analyze PPP rules with perfect capital mobility, that is, when covered interest parity always hold, and show that the rules stabilize output but increase price variability.

[3]Edwards (1985) shows that expectation-adjusted domestic interest rates have systematically converged to world interest rates in Columbia, even though trading of foreign securities has been severely limited in that country.

[4]Accordingly, a θ that maintains the real exchange rate need not exist. And, indeed, such a θ does not always exist in the numerical simulations examined below.

[5]Assuming that a bar above a variable indicates its steady state value, then equation (5) can be re-written as

$$(m^d - \bar{m}^d) = (p - \bar{p}) - \delta(\tilde{x}_{+1} - x) .$$

In the steady state, the demand for money is governed by the quantity theory or

$$\bar{m}^d = \bar{k} + \bar{y} + \bar{p}$$

where $\bar{k}$ is the long-run velocity. Substituting this expression into equation (5), one obtains the original (not in deviation form) specification of the money demand equation used in the text, or

$$m^d = \bar{k} + \bar{y} + p + \delta(\tilde{x}_{+1} - x) .$$

Because the money market is always in equilibrium, that is, $\bar{m}^d = \bar{m}^s$, it is implicitly assumed that $\bar{m}^s = \bar{k} + \bar{y}$.

[6]Both Dornbusch's model and this one boil down to a stochastic difference equation in the wage rate. If the money demand depended on the expected changes in the price level or in the exchange rate, the model would involve the solution of a second order difference equation system in the wage rate and the exchange rate.

[7]To obtain (10), I used the relations $x_{-1} = (1 - \rho B)^{-1}u_{-1}$, and $\tilde{x}_{+1} = [(1 - \rho B)^{-1} - 1]\rho u$ where B is the backshift operator.

[8]I also reduce the value of the money demand elasticity, which does not appear in Dornbusch's model, to -.1 because the model would not have stable roots for higher elasticity values.

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Table 1: Reserves and Implicit Private Capital Outflows in Selected Countries: 1981-1982
(in billions of U.S. dollars)

Country	Stock of Reserves at the end of: 1980	1981	Implicit Capital Outflows[1] 1981	1982
Argentina	6.06	2.59	-	3.17
Mexico	2.69	3.71	-2.50	6.22
Venezuela	5.63	7.08	3.10	-1.47
Chile	3.04	3.12	0.75	1.36
Korea	2.91	2.62	0.03	1.67
Indonesia	5.01	4.52	2.99	1.27
Turkey	1.27	1.28	-2.61	0.71
Portugal	0.75	0.47	0.12	-4.14

[1]The implicit capital outflows are estimated by subtracting from reported changes in gross external indebtedness, the current account deficit and changes in net foreign assets of the central bank and commercial banks. A plus sign indicates implicit capital outflows. This methodology is used in Dooley, Helkie, Tyron and Underwood (1985). The sources of the data are International Financial Statistics, IMF and World Debt Tables, 1983-84, World Bank.

Table 2: Price and Output Variability

Parameter Values	Variances and Wage Persistence	Value of θ			
		.1	.5	1.0	1.5
1) $a = 1$ $\delta = -.2$	σ_p^2	.019	.079	.266	.470
	σ_y^2	.149	.080	.048	.035
	ρ	.511	.574	.629	.668
2) $a = 2$ $\delta = -.1$	σ_p^2	.005	.102	.303	.512
	σ_y^2	.133	.074	.047	.036
	ρ	.517	.580	.634	.673
3) $a = 1$ $\delta = -.6$	σ_p^2	.256	.105	.246	.494
	σ_y^2	.113	.105	.131	.158
	ρ	.543	.621	.689	.735

Note: The values of the other parameters are $\phi = \gamma = \psi = b = .5$.