

Overshooting Meets Inflation Targeting*

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1. The Basis of Overshooting

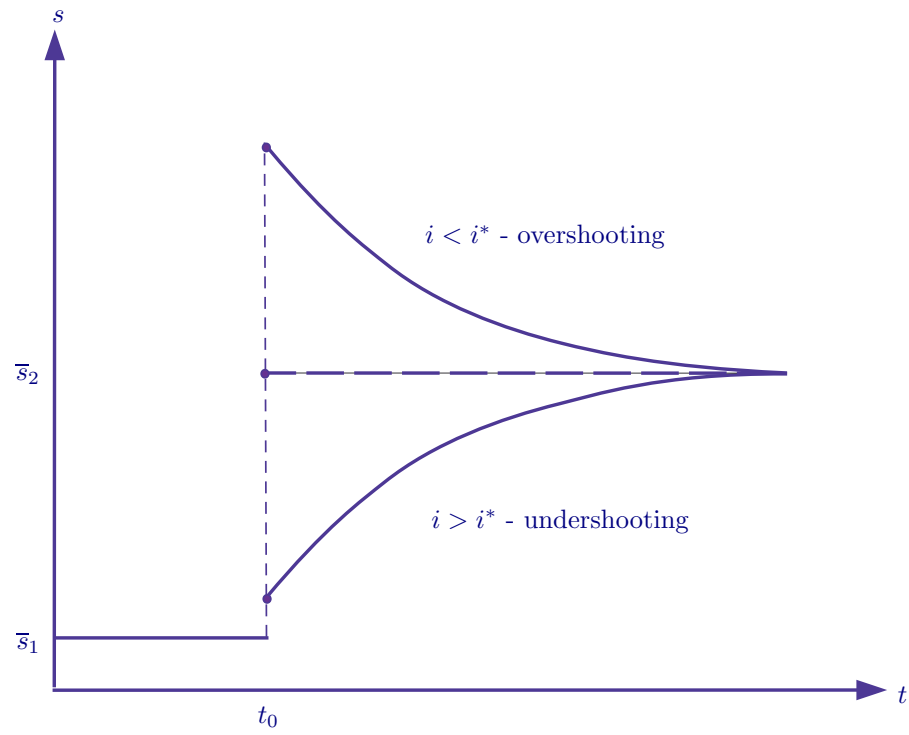
Uncovered interest rate parity:

$$i_t = i_t^* + E_t s_{t+1} - s_t. \quad (1)$$

Assume a permanent monetary expansion: $M_{t+1} = (1 + \theta)M_t$, hence $\bar{s}_{t+1} = (1 + \theta)\bar{s}_t$.

If the monetary expansion reduces the interest rate, hence $E_t s_{t+1} - s_t$ must be negative \rightarrow the exchange rate must appreciate to a more depreciated long run equilibrium \rightarrow *overshooting*.

If the monetary expansion increases the interest rate (!) \rightarrow *undershooting*.



2. Overshooting Vintage 1976

The original version. The model can be described by the following four equations, which are uncovered interest rate parity, aggregate demand, the Phillips curve and money market equilibrium, respectively:

$$i = i^* + \dot{s}, \quad (2)$$

$$y = \bar{y} + \phi(s - p), \quad (3)$$

$$\dot{p} = \lambda(y - \bar{y}), \quad (4)$$

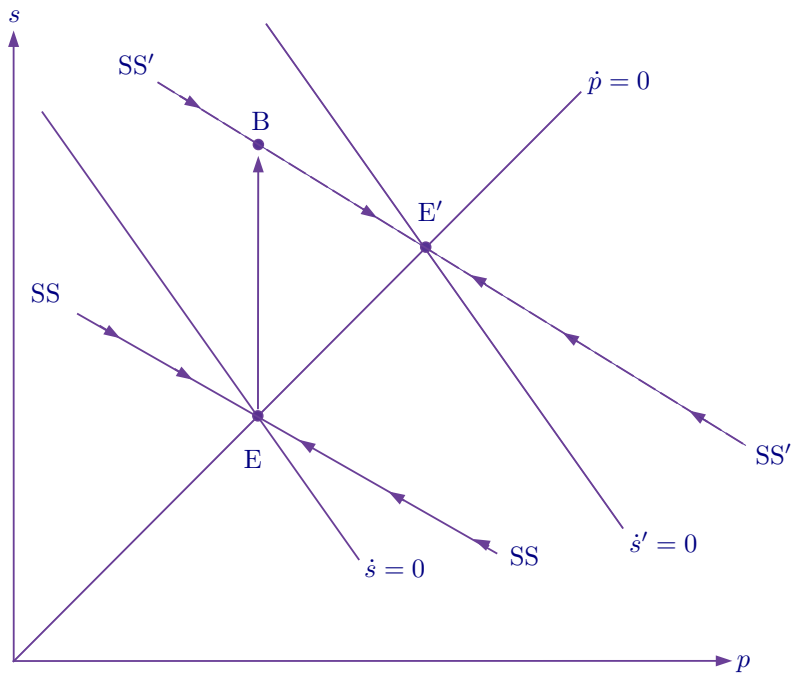
$$m - p = -\eta i + \kappa y. \quad (5)$$

Solving for y and i , we have the following dynamic equations that describe the evolution of prices and the exchange rate:

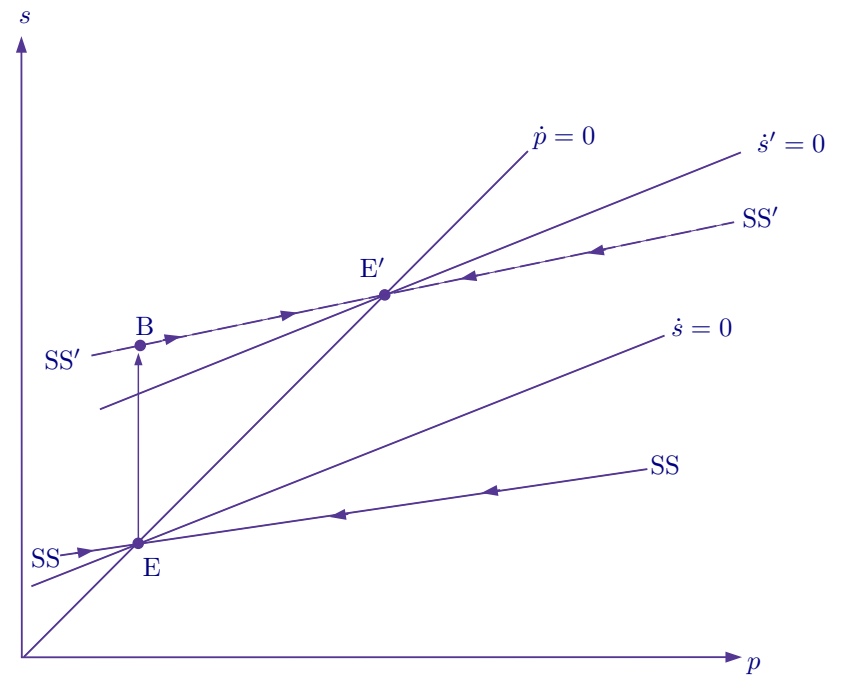
$$\dot{p} = \phi\lambda(s - p), \quad (6)$$

$$\dot{s} = \frac{\kappa}{\eta}\bar{y} - \frac{1}{\eta}m - i^* + \frac{\kappa\phi}{\eta}s + \frac{1 - \kappa\phi}{\eta}p. \quad (7)$$

If $\kappa\phi < (>)1$ then the locus for $\dot{s} = 0$ will be negatively (positively) sloped.



Overshooting ($\kappa\phi < 1$)



Undershooting ($\kappa\phi > 1$)

Monetary policy rules. A more promising area may be to model policymaking in a more realistic framework. Let's assume the following Taylor-type rule:

$$i = i^* + a(p - \bar{p}) + b(y - \bar{y}). \quad (8)$$

The objective of the monetary authority is the price level rather than inflation to avoid indeterminacy. Using the rule given by (8) it can be shown that the $\dot{s} = 0$ schedule is given by:

$$s = \left(1 - \frac{a}{b\phi}\right) p + \frac{a}{b\phi} \bar{p}. \quad (9)$$

When $\frac{a}{b\phi} > 1$ there is overshooting, and when $\frac{a}{b\phi} < 1$ there is undershooting. But for undershooting we still need an increase in interest rate when the price level target rises (!).

Imperfect capital mobility. With imperfect capital mobility is possible to have both *undershooting and decline in interest rate* as result of a monetary expansion. The cost of foreign financing is increasing in the current account, this is:

$$i = i^* + \dot{s} - \beta\phi(s - p). \quad (10)$$

In this case we have that the $\dot{s} = 0$ -schedule is:

$$s = \left(1 - \frac{1}{K\phi + \eta\phi\beta}\right) p + \frac{m + i^*\eta - \kappa\bar{y}}{\eta}. \quad (11)$$

For all $\beta > (1 - \kappa\phi)/\eta\phi$, the slope of $\dot{s} = 0$ is positive and we have undershooting. It is possible that a monetary expansion increases interest rates and induces an expected depreciation because the risk premium falls more than i . We require strong expenditure switching effects as result of the initial depreciation on the current account. So, a monetary expansion would induce an improvement in the current account balance (!).

3. Exchange Rates in a Dynamic New-Keynesian General Equilibrium Model (DNK)

Until now we have not been able to generate very plausible undershooting. However, monetary policy responds to many different shocks. The evolution of the exchange rate will depend on the nature of the shock. The purpose of what follows is to analyze the evolution of the exchange rate in a general equilibrium model with sticky prices.

The equations of the model are an aggregate demand, a Phillips curve for inflation of home goods, the definition of inflation where tradable goods are subject to PPP, uncovered interest rate parity, and the policy rule where the interest rate adjust gradually to a Taylor-type rule:

$$y_t = E_t y_{t+1} + \phi_\pi E_t \pi_{H,t+1} - \phi_e (E_t s_{t+1} - s_t) - \phi_i i_t + \epsilon_{y,t} + (1 - \rho_z) \epsilon_{z,t}, \quad (12)$$

$$\pi_{H,t} = \beta E_t \pi_{H,t+1} + \lambda_y y_t + \lambda_q (s_t + p_t^* - p_{H,t}) + \epsilon_{\pi,t}, \quad (13)$$

$$\pi_t = \gamma \pi_{H,t} + (1 - \gamma) (s_t - s_{t-1}), \quad (14)$$

$$i_t = i_t^* + E_t s_{t+1} - s_t, \quad (15)$$

$$i_t = (1 - \rho_i) [\chi_\pi (E_t \pi_{t+k} - \bar{\pi}) + \chi_y y_t + \chi_s s_t + \epsilon_{i,t}] + \rho_i i_{t-1}. \quad (16)$$

Where $\chi_s = 0$ for flexible exchange rate and $\chi_s > 0$ for managed exchange rate.

4. Calibration and Simulations

The model is calibrated for the Chilean economy.

We analyze the impact of four type of shocks:

- Transitory inflation target.
- Foreign interest rate.
- Productivity.
- Cost push.

All of them are transitory shocks, following an AR(1) process with an auto-correlation coefficient of 0.7.

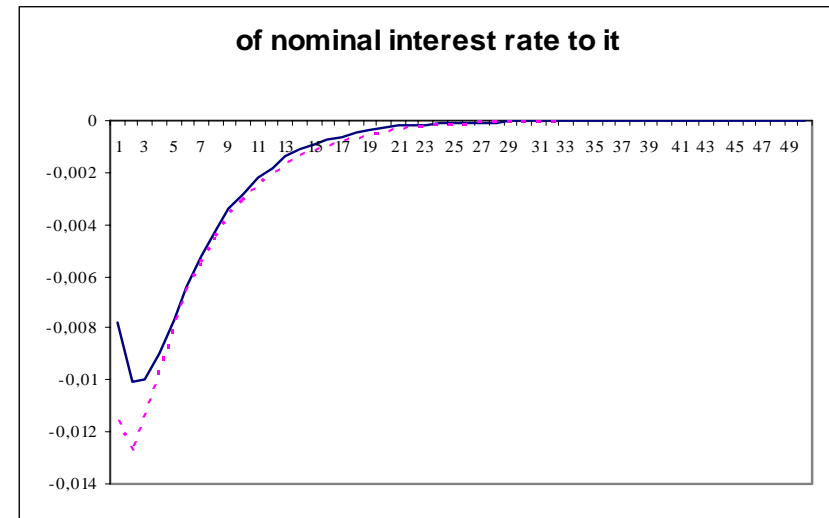
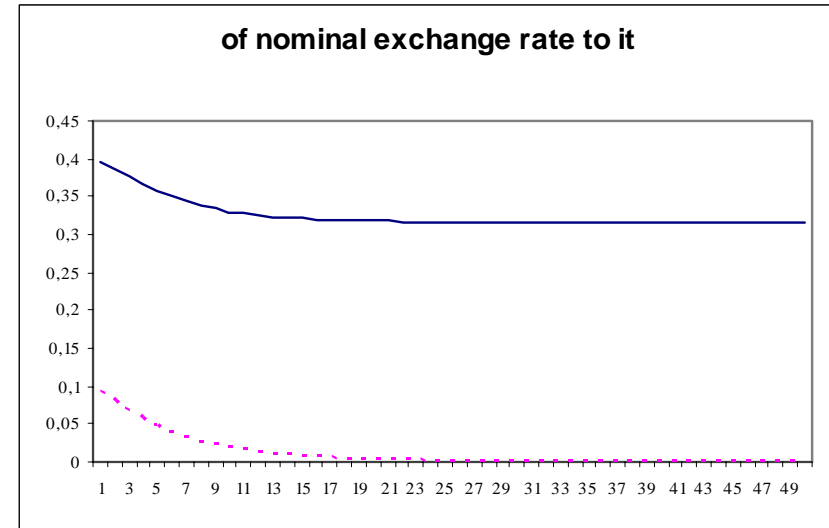
A permanent monetary expansion. Furthermore, under our calibration, the impact of both foreign interest rate and technology shocks entails a parallel reaction of the exchange rate: overshooting. While, under cost push shocks the exchange rate depreciates on impact and then rises again persistently above the steady state (undershooting). In the augmented Taylor rule we cannot properly define over- or under-shooting, but certainly the impact of shocks on the exchange rate are attenuated by fear of floating.

A Dornbusch exercise in a DNK model: inflation target shock

- To demonstrate the dynamic properties of the model, we hit the economy with an inflation target shock. This shock could be interpreted as a permanent monetary expansion as in the original Dornbusch exercise.
- The results are consistent with the original exercise where the exchange rate overshoots its long-run equilibrium. In particular, an inflation target innovation causes a reduction in the interest rate and hence, there should be an expected appreciation of the exchange rate to compensate for the lower return of domestic currency.
- As in the original case, the only possibility to combine a long-term depreciation together with an expected appreciation is to have, on impact, a nominal depreciation larger than the long-run equilibrium.

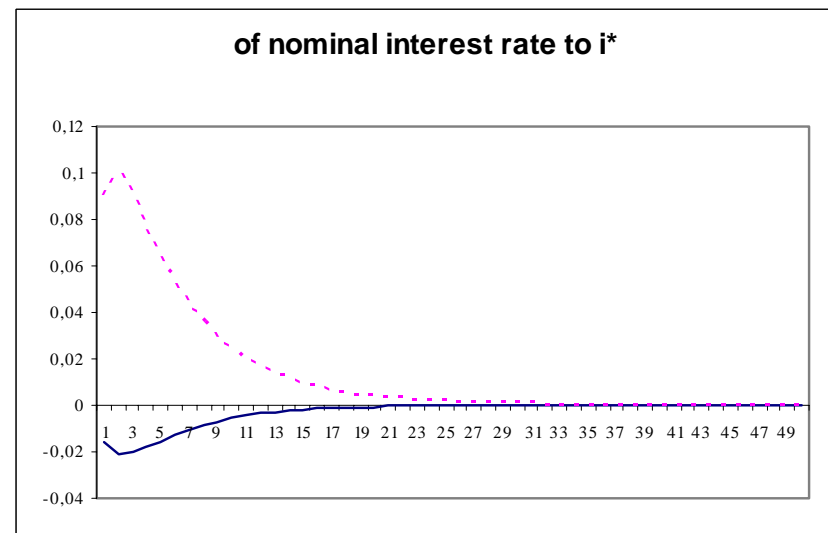
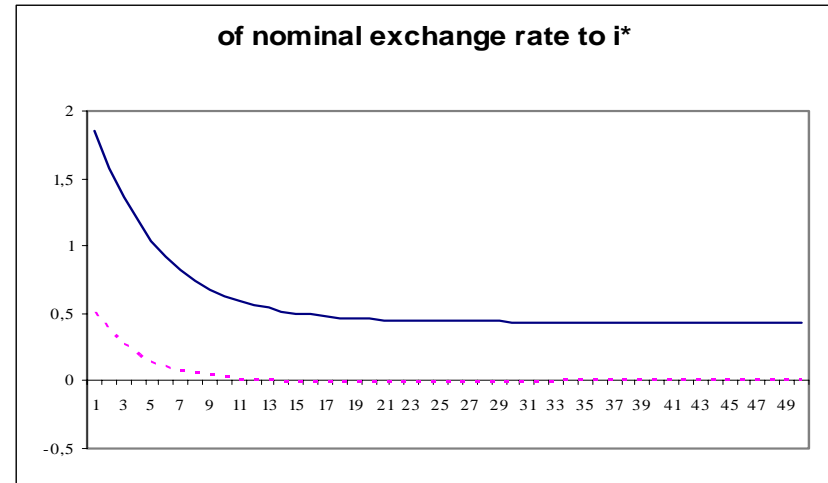
A Dornbusch Exercise in a DNK model: inflation target shock

- If the central bank exercises some control over the nominal exchange rate, the impact of an inflation target shock (and consequently its volatility) is more limited than the case without foreign exchange intervention.
- The only exception is the nominal interest rate that tends to react more if the nominal exchange rate is managed because the overshooting feature is not present and hence the fall in the interest rate is not compensated by fluctuations in the exchange rate.



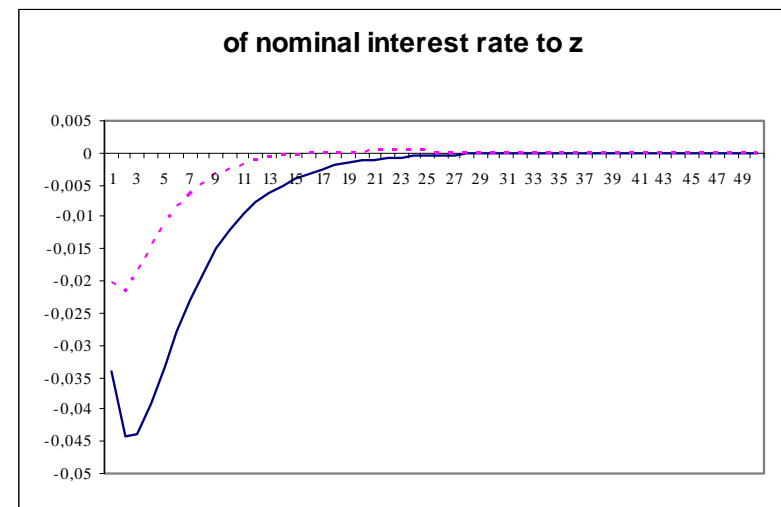
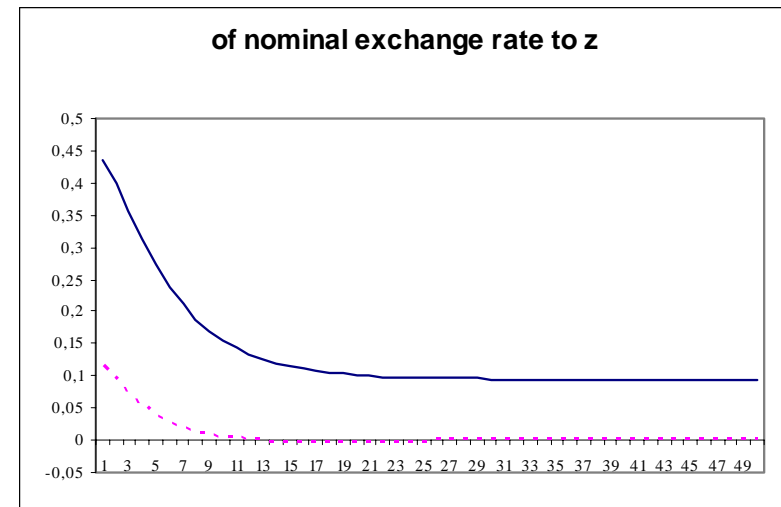
Foreign interest rate shock

- Under flexible exchange rates, a foreign interest rate shock produces a considerable nominal depreciation, which has a significant impact on CPI inflation.
- Similar, to the inflation target shock, the foreign interest rate shock results in a exchange rate that stays persistently above the initial steady state.
- On the other hand, if the central bank exercises some control over the nominal exchange rate, the domestic interest rate rises to match the foreign disturbance that hits the economy, at least partially.



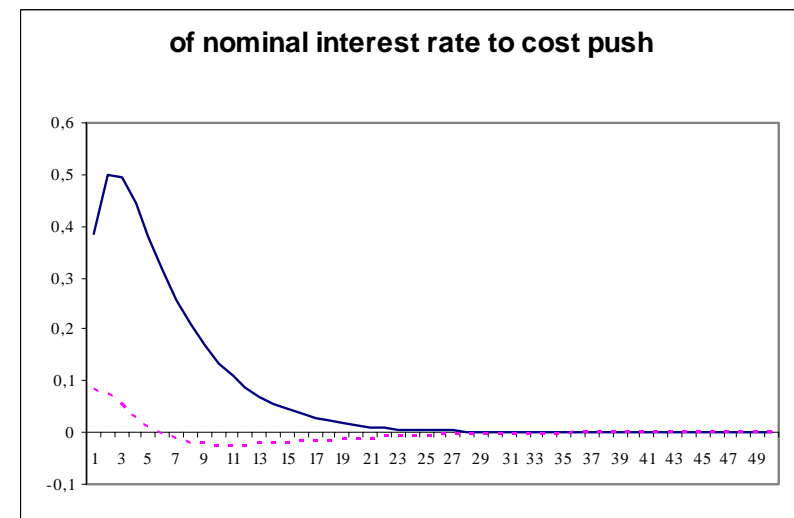
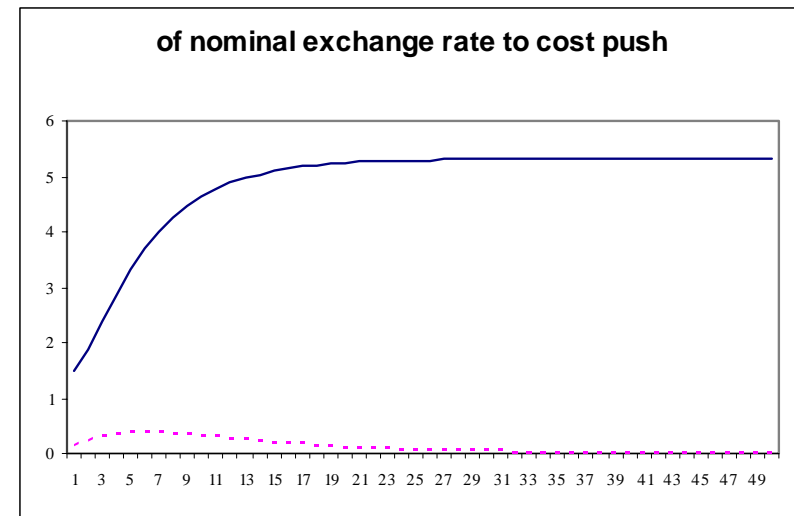
Productivity shock

- Uncovered interest parity implies an initial nominal depreciation followed by expectations of a future appreciation, as reflected in the response of the nominal exchange rate.
- The increase in domestic productivity and the required real depreciation lead, for given domestic prices, to an increase in CPI inflation.
- Under a managed exchange rate, the nominal interest rate fell just half way without letting the currency to depreciate leads to an amplification of the responses of the output gap and domestic inflation.



Cost-push shock

- The cost-push shock has the most different implications of the other shocks considered in the model. In particular, a positive cost push shock has an immediate impact in both domestic and CPI inflation.
- The nominal exchange rate depreciates strongly on impact and it is followed by expectations of further depreciation → undershooting.
- Under managed exchange rates, the shock is absorbed by domestic prices and not by the nominal exchange rate. Therefore, the real exchange rate appreciates considerably with the consequent negative impact on output.



5. Concluding Remarks

- Although this model could generate some realistic correlations still volatility of exchange rates is small with respect to the volatility of prices. This is a traditional problem with calibrated general equilibrium problems in its ability to replicate asset prices volatility. One possible way to reduce inflation volatility respect to exchange rate volatility may be to add more persistence in the inflation process adding some inertia in the Phillips curve.
- The model incorporates an exchange rate objective in the policy function, but does not allow for sterilized intervention. In addition, there is a target for the long-run. This could be a reasonable working assumption to compare rules, but not quite the best description of what actually policymakers do. Fear of floating is more related to sudden and sharp changes in the exchange rate rather than targeting a specific level.