Reflections on Monetary Policy Choices in the Open Economy: Implications from an Optimizing Model

Richard H. Clarida
C. Lowell Harriss Professor of Economics
Columbia University and NBER
rhc2@columbia.edu

September 24, 2007

Abstract

The purpose of this paper is to provide some intuition and insight into monetary policy choices faced in the open economy. The approach we pursue is to 'inspect the mechanism' of the two country Clarida, Gali, Gertler (2002) optimizing model by focusing on the three main building blocks that can be derived from it: the 'open economy' IS curve, the open economy Phillips curve, and the open economy Taylor rule. We emphasize the following results that are based open a benchmark specification of the model which assume that the elasticity of intertemporal substitution in consumption is less than 1.

First, there will in general be a spillover from foreign output to potential domestic output. Second, there will in general be a spillover from foreign output growth to the domestic neutral real interest rate. Third, we show that a more open economy has a flatter IS curve. Fourth, we show that a more open economy has a flatter Phillips curve . We discuss that a more open economy places a larger weight on inflation stabilization in the appropriately derived quadratic approximation to the social welfare function. Sixth, we review that optimal monetary policy in the open economy can be written as a Taylor rule in the neutral real interest rate and expected domestic inflation. Seventh, we show that in a more open economy the optimal Taylor rule coefficient on expected inflation is smaller than in a more closed economy, so that the central bank needs to lean less against the wind for any given inflation shock. Eighth, while a Taylor rule is one way to write the optimal policy rule, the optimal policy rule can also be written as an augmented Taylor rule that includes the rate of nominal exchange rate depreciation and the home - foreign growth differential. Ninth, there is a presumption that, under optimal monetary policy, bad news about inflation will be good news for the exchange rate.

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1. **Introduction**

A perennial topic of discussion among scholars and policymakers is how best to think about a benchmark for macroeconomics as it applies to monetary policy. Should the benchmark for policy analysis be the open economy with international interest rate linkages and flexible exchange rates (after all, major economies are in fact open with flexible exchange rates), or should it be the closed economy in which such linkages and exchange rate adjustments are assumed away. Of course, few if any policymakers would seek to guide policy by ignoring capital flows and exchange rates, but in many cases it appears as though the starting point for analysis is the closed economy macro model, these days a variant of the dynamic new Keynesian model.

Those who start from a closed economy framework often have questions about how 'openness' influences the analysis. How does the neutral real interest depend on 'global' developments? Is the Phillips curve trade off between inflation and domestic output better or worse in the open versus the closed economy? Is 'potential GDP' a function of global developments, or only of domestic resources available and domestic productivity? Perhaps most importantly, how – if at all - does openness influence the optimal monetary policy rule? Or, perhaps more in the spirit of this conference: *Is a Taylor rule the right monetary policy for an open economy?*

In 2002 Jordi Gali, Mark Gertler, and I published a paper in the *Journal of Monetary Economics* that developed a benchmark (at least in our way of thinking) dynamic two country optimizing macro model of optimal monetary policies in the open economy. Our focus in that paper was deriving optimal policy rules in the two country model and assessing the gains from international monetary policy cooperation. In that paper, we emphasized the following implications of the model:

- Optimal monetary policy in each open economy can be written as a Taylor Rule, linear in the 'domestic' equilibrium real interest rate and the gap between domestic inflation and the inflation target.

- In general, there are gains to international monetary policy cooperation . Optimal monetary policy under cooperation can be written as Taylor rule in which the domestic as well as the foreign inflation gap enters the reaction function, as well as the equilibrium real interest rate.

- Optimal policy features a flexible exchange rate and the nominal exchange rate under optimal discretionary policy has a unit root as does the domestic price level and they are cointegrated. Optimal monetary policy produces a 'random walk' nominal exchange rate because under discretion, the central bank cannot credibly commit to a price level target (but can only achieve a stationary inflation rate).

The purpose of this paper is to provide some intuition for these results and to develop some further insights into monetary policy in the open economy. The approach we pursue is to 'inspect the mechanism' of the two country CGG (2002) optimizing model by focusing on the three main building blocks that can be derived from it: the 'open economy' IS curve, the open economy Phillips curve, and the open economy Taylor rule. Because these building blocks are derived from a two country optimizing model, we can use them to gain insight into how special is the 'special case' of the closed economy framework which does appear to be the starting point for much contemporary monetary policy analysis. For those readers who are impatient to determine if it worth reading further, here are our main results.

First, there will in general be a *spillover from foreign output to potential domestic output*. The more open is the economy, the larger is this spillover to domestic potential output from foreign output. 'Trend' or potential output growth is not in general independent of global developments.

Second, there will in general be a *spillover from foreign output growth to the domestic neutral real interest rate*. In our benchmark case this spillover is positive so faster foreign growth, whether due to potential growth or the business cycle, raises the neutral domestic real interest rate. Moreover, the more open the economy is, the larger is this effect of foreign growth on the domestic real interest rate and the smaller is the effect of domestic growth on the domestic real interest rate.

Third, we show that *a more open economy has a flatter IS curve,* so that the central bank gets more bang out of every basis point buck by which it changes the policy rate in an open economy than in an otherwise identical closed economy.

Fourth, we show that *a more open economy has a flatter Phillips curve* so that there is a smaller reduction in domestic inflation for any given decline in domestic output.

Fifth, Clarida, Gali, and Gertler (2002) prove and we discuss that *a more open economy places a smaller weight on output stabilization and thus a larger weight on inflation stabilization in the appropriately derived quadratic approximation to the social welfare function.*

Sixth, we show *that optimal monetary policy in the open economy can be written as a Taylor rule in the neutral real interest rate and expected domestic inflation*.

Seventh, we show that *in a more open economy the optimal Taylor rule coefficient on expected inflation is smaller than in a more closed economy, so that the central bank needs to lean less against the wind for any given inflation shock.*

Eighth, while a Taylor rule is one way to write the optimal policy rule, *the optimal policy rule can also be written as an augmented Taylor rule that includes the rate of nominal exchange rate depreciation and the home - foreign growth differential*.

Ninth, there is a presumption that, under optimal monetary policy, *bad news about inflation will be good news for the exchange rate* as documented in Clarida and Waldman (2006).

2.1 Essence of the Model

The complete model is presented in CGG (2002) and is sketched out in this section. There are two countries, producing differentiated tradable final goods from a continuum of intermediate labor varieties. Households share identical Cobb-Douglass preferences over a consumption index C_t of home and foreign varieties. A key parameter is γ which is the share of home spending on foreign goods. The larger is γ, the more open is the home economy, which is the economy we shall focus on for the purposes of this discussion. The law of one price holds and there is producer currency pricing. Under these assumptions (see Cole-Obstfeld (1991) and Corsetti – Pesenti (2000)) the complete markets allocation can be achieved though endogenous adjustments in the equilibrium terms of trade, denoted by S_t , that clear the world goods market.

Household utility takes the standard form

$$U(C_t) - V(N_t(h)) = \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t(h)^{1+\phi}}{1+\phi} \quad (1)$$

Where $1/\sigma$ is the intertemporal elasticity of substitution of consumption, and $N_t(h)$ is labor supply. We focus on benchmark case with $\sigma > 1$. However, as we discuss below, this assumption is not innocuous.

Firms produce final output from a variety of intermediate inputs $Y_t(f)$.

$$Y_t = \left(\int_0^1 Y_t(f)^{\frac{\xi-1}{\xi}} df \right)^{\frac{\xi}{\xi-1}} \quad (2)$$

Each intermediate input $Y_t(f) = A_t N_t(f)$ is produced from a variety of labor inputs and an exogenous productivity shock A_t where

$$N_t(f) = \left(\frac{1}{1-\gamma} \int_0^{1-\gamma} N_t(h)^{\frac{\eta_t-1}{\eta_t}} dh \right)^{\frac{\eta_t}{\eta_t-1}} \quad (3)$$

We note that each household (and each input producer) has market power because labor varieties (and intermediate inputs) are heterogeneous and imperfectly substitutable. However, while we assume that money wages are flexible, intermediate goods prices are sticky.

Firms will set prices as a mark up over marginal cost. Real marginal cost is just the real product wage scaled by productivity $MC_t = (1 - \tau)\{W_t/P_{H,t}\}A_t^{-1}$. In our open economy this can be written as

4) $$\frac{(1-\tau)(W_t / P_t)S_t^{\gamma}}{k\, A_t}$$

where P_t is the CPI , τ is a wage subsidy, and $k = (1-\gamma)^{(1-\gamma)}\gamma^{\gamma}$. From the first order condition for labor supply we have $\frac{W_t}{P_t} = (1+\mu_t^w)\, N_t(h)^{\phi} C_t^{\sigma}$ where $1 + \mu_t^w = \eta_t / \{\eta_t - 1\}$ is a wage mark up. With flexible wages, all workers are paid the same wage and work the same hours so the h indicator is redundant and will be suppressed below.

2.2 Some Equilibrium Conditions

The following equilibrium conditions hold in both the flexible price and sticky price equilibrium. In equilibrium current accounts are in balance period by period and the consumption index satisfies

5) $$C_t = k\,(Y_t)^{1-\gamma}(Y_t^*)^{\gamma}$$

where Y_t* is foreign output. The equilibrium terms of trade that brings this about is

6) $$S_t = \frac{Y_t}{Y_t^*}$$

In equilibrium, the amount of home output produced will depend on labor supply, productivity, as well as the dispersion across firms in the prices of intermediate goods

7) $$Y_t = \frac{A_t N_t}{V_t}$$

where V_t is an index of price dispersion across intermediate input sellers

8) $$V_t = \int \left(P_{h,t}(f) / P_{h,t}\right)^{-\xi} df$$

From all this it follows that equilibrium real marginal cost in the open economy MC_t can be written as

9) $$MC_t = (1-\tau)k^{\sigma-1}(1+\mu_t^w)A_t^{-(1+\phi)}Y_t^k\left(Y_t^*\right)^{k0}V_t^{\phi}$$

where

10) $$\kappa = \sigma(1-\gamma) + \gamma + \phi$$

and

11) $$\kappa_0 = \sigma\gamma - \gamma$$

Marginal Cost Spillovers

The sign of the effect of foreign output on home marginal cost is given by κ_0. Under our assumption that $\sigma > 1$, κ_0 is positive and thus, so is the spillover from foreign output to domestic marginal cost. A rise in foreign output improves the home terms of trade and this, by increasing the purchasing power of home wages, will tend to lower home marginal cost with an elasticity of γ. But the improvement in the home terms of trade will also raise the consumption index and lower the marginal utility of work, and thus raise marginal cost with an elasticity of $\gamma\sigma$. In the benchmark case $\sigma > 1$, this income effect from a foreign output expansion dominates the substitution effect and marginal cost spillovers are positive. However, if $\sigma < 1$ the substitution effect dominates and a rise in foreign output lowers home marginal cost. In the knife-edge case $\sigma = 1$, there are no international spillovers to home marginal cost.

Although our focus will be on the sticky price equilibrium, it is useful to solve for the flexible price equilibrium, the case where all firms can change their price every period. In this case, $P_{H,t}$ will be common across firms and will be a constant markup over nominal marginal cost, so that real marginal cost will be constant and equal to $\overline{MC} = \frac{1}{1+\mu^p}$ where an overstrike represents the flexible price equilibrium and $1 + \mu^p = \xi/\{\xi - 1\}$. Every firm will choose the same price so $V_t = 1$ and we have

12) $$\overline{Y}_t = A_t \overline{N_t}$$

Using (9) which always holds and the expression for real marginal cost which holds under flexible prices, we can solve for the 'natural' level of home output consistent with a given level of foreign output and the mean level of the wage markup

13) $$\overline{Y}t = \left(\frac{k^{1-\sigma} A_t^{1+\phi} (Y_t^*)^{-\kappa 0}}{(1-t)(1+\mu^w)(1+\mu^p)} \right)^{1/\kappa}$$

Thus in the open economy the natural rate of output is a function of foreign output unless σ = 1. When σ > 1, a rise in foreign output, holding constant home productivity, raises home marginal cost and this lowers home natural output because the income effect from the terms of trade gain lowers the flexible price labor supply. Moreover, this effect is larger the more open is the economy. Note however that if the source of the rise in foreign output is a productivity shock that is positively correlated with home productivity, the reduced form correlation between home natural output and foreign output can be positive even for the case σ > 1.

3. The Open Economy IS Curve

In this model, as in many other new open economy macro models, the path for optimal consumption must satisfy an Euler equation of the form

$$c_t = E\{c_{t+1}\} - \frac{1}{\sigma}(r_t - E_t\{\pi_{t+1}\} - \gamma E_t\{\Delta s_{t+1}\}) \qquad 14)$$

where r_t is the nominal interest rate, π_t is domestic inflation, and lower case letters for all other variables denote log deviations from the non-stochastic steady state. We note that $\pi^{CPI}_{t+1} = \pi_{t+1} + \gamma \Delta s_{t+1}$. How do we turn this into an open economy *IS* curve? We start by recognizing that with balanced trade $y_t = c_t + \gamma\, s_t$ and substitute out for c_t and c_{t+1} . We obtain an Euler equation in y_t.

$$y_t = E_t\, y_{t+1} + \gamma\, s_t - \gamma E_t\, s_{t+1} - \sigma^{-1}(r_t - E_t\{\pi_{t+1}\} - \gamma E_t\{\Delta s_{t+1}\})$$

The terms of trade plays several roles. As in static models, a terms of trade worsening boosts exports and increases demand for domestic output. But an anticipated terms of trade worsening raises expected inflation and lowers the consumption real interest rate for any given nominal interest rate. Consider the special case in which $E_t\, y_{t+1} = \rho y_t$ and $E_t\, s_{t+1} = \rho s_t$ (which in fact will be the case under optimal monetary policy with an exogenous home cost push shock, no foreign cost push shock, and constant productivity as shown in CGG(2002)). In this case the open economy IS curve can be written as

$$y_t = \gamma(1 - \sigma^{-1})\, s_t - \{(1-\rho)\,\sigma\}^{-1}(r_t - E_t\,\pi_{t+1}) \qquad 16)$$

This is form of the IS curve often found in traditional overshooting literature. We note that with the benchmark case $\sigma > 1$, a rise in s_t which increases the relative price of foreign goods in terms of home goods will boost aggregate demand for home output. Of course, a rise in the real interest rate reduces aggregate demand for home output.

In this particular model, we have more structure so we can say more about the open economy IS curve. We know that $s_t = y_t - y^*_t$ So we can substitute out for s_t. Defining the log domestic output gap $\tilde{y}_t = y_t - \bar{y}_t$, we obtain

$$17) \qquad \tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \sigma_0^{-1}[r_t - E_t\{\pi_{t+1}\} - \overline{rr}_t]$$

where

$$18) \qquad \overline{rr}_t = \sigma_0 E_t\{\Delta\bar{y}_{t+1}\} + k_0 E_t\{\Delta y^*_{t+1}\}$$

is the domestic natural real interest rate with

$$19) \qquad \sigma_0 = \sigma - \gamma(\sigma - 1)$$

where it will be recalled that $\kappa_0 = \gamma(\sigma - 1)$. In our benchmark case σ > 1 and $\kappa_0 > 0$. Also note for the benchmark case that σ_0 is decreasing in γ, the parameter that indexes openness.

There is a lot going on here, so let's take stock. We have derived an open economy *IS* curve in terms of the domestic output gap and the gap between the domestic real interest rate and the appropriate natural real interest rate. How is this an open economy IS curve? First, as discussed above, the *natural rate of output in the open economy depends on the level of foreign output*

$$\bar{Y}t = \left(\frac{k^{1-\sigma} A_t^{1+\phi} (Y_t^*)^{-\kappa_0}}{(1-t)(1+\mu^w)(1+\mu^p)} \right)^{1/\kappa}$$

and thus does the domestic output gap depend on foreign output.

Second, the slope of the open economy is curve depends on how open the economy is. In our benchmark case $\sigma > 1$, the semi – elasticity of aggregate demand for domestic output with respect to the real interest rate is increasing in openness. In other words, in our benchmark case, *a more open economy has a flatter IS curve,* so that the central bank gets more bang out of every basis point buck by which it changes the policy rate.

Third, the appropriate natural or neutral real interest rate depends on foreign output growth as well as home output growth

$$\overline{rr}_t = \sigma_0 E_t\{\Delta \overline{y}_{t+1}\} + k_0 E_t\{\Delta y^*_{t+1}\}$$

In the special case $\sigma = 1$ this reduces to the standard growth model in which the neutral real interest rate is equal to the domestic growth rate in potential output. In the benchmark case with $\sigma > 1$, κ_0 is positive, and the *neutral domestic real interest rate is positively correlated with foreign growth*. Moreover, *the more open is the economy, the more important is the effect of foreign output growth on the domestic real interest rate.*

4. The Open Economy Phillips Curve

We assume as in Calvo that prices of domestic intermediate goods are sticky and that a constant fraction $1 - \theta$ firms can change price every period. The optimal price chosen at date t is given by

$$E_t \sum_{j=0}^{\infty} \theta^j Q_{t,t+j} Y_t(f)(P^0_{H,t} - (1+\mu^p) P_{H,t+j} MC_{t+j}) = 0$$

where $Q_{t,t+j}$ is the standard stochastic discount factor. With this standard staggered price model, the domestic price index evolves according to

21) $$P_{H,t} = [\theta (P_{H,t-1}) + (1-\theta)(P^0_{H,t})]^{\frac{1}{1-\xi}}$$

From this it follows that domestic inflation evolves according to

22) $$\pi_t = \delta\, mc_t + \beta\, E_t\{\pi_{t+1}\}$$

where $\delta = \dfrac{(1-\theta)(1-\beta\theta)}{\theta}$

Thus domestic inflation in the open economy is driven by the present value of log real marginal cost. But what is log real marginal cost in the open economy? One way to express log real marginal cost is simply

23) $$mc_t = \mu^w{}_t + \phi\, n_t + \sigma\, c_t + \gamma\, s_t - a_t$$

As is evident from this equation, other things equal an *improvement in the home terms of trade , a fall in* s_t, *lowers real marginal cost* and is thus disinflationary. Moreover, the more open the economy, the larger is the effect of the terms of trade on real marginal cost and thus inflation.

Given the structure of our model, it is possible to express real marginal cost as a function of home output, foreign output, and productivity.

24) $$mc_t = \mu_t^w + \kappa\, y_t + \kappa_0 - (1+\phi)a_t$$

However, from the definition of domestic natural output, we know that $y_t = k^{-1}[(1+\phi)a_t - \kappa_0 y_t^*$. It follows that in equilibrium log of real marginal cost can be written as

25) $$mc_t = \kappa\, \tilde{y}_t + \mu_t^w$$

Where it will be recalled that $\kappa = \sigma(1-\gamma) + \gamma + \phi$

The open economy Phillips curve follows immediately

26) $$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda \tilde{y}_t + u_t$$

where $\lambda = \delta\kappa$. We see that, in our benchmark case of with $\sigma > 1$, *the more open economy has a flatter Phillips curve* . The intuition is as follows. The more open the economy, the smaller is the impact of a change in domestic output on the domestic consumption index and thus the marginal utility of consumption, so this tends to reduce the impact of domestic output on marginal cost. However, the more open the economy the greater is the impact on marginal cost of the terms of trade change that follows from a change in output. In our benchmark case, the income effect of the rise in output outweighs the induced effect of the terms of trade change , resulting in a flatter open economy Phillips curve.

5. *Optimal Policy Rules in the Open Economy*

Combining our IS and Phillips curve and terms of trade equations, we have

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \sigma_0^{-1}[r_t - E_t\{\pi_{t+1}\} - \overline{rr}_t]$$

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda \tilde{y}_t + u_t$$

$$s_t = (\tilde{y}_t - \tilde{y}_t^*) + (\bar{y}_t - \bar{y}_t^*)$$

Where the home country takes foreign output as given. To close the model, we need to specify a path for the home nominal interest rate.

As is customary in this literature, we assume the central bank maximizes

27) $$W^H = -(1-\gamma)\frac{\Lambda}{2} E_0 \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \alpha\, \tilde{y}_t^2]$$

CGG (2002) show that how this quadratic approximation to the social welfare function in the open economy can be derived as in Woodford (2003) and that at a social optimum $\alpha = \lambda/\xi$. Thus, in our benchmark case, we see that *a more open economy places a smaller weight on output stabilization and thus a larger weight on inflation stabilization .* This follows directly from the fact that the more open economy has a flatter Phillips curve under our benchmark case.

Under discretion optimal policy must satisfy the following first order conditions

28) $$\tilde{y}_t = -\frac{\lambda}{\alpha} \pi_t$$

29) $$\pi_t = \Psi\, u_t$$

with $\Psi = [(1-\beta\rho) + \lambda\xi]^{-1}$, and where ρ is the exogenous autocorrelation in shocks to the markup. One way to write the optimal monetary policy in the open economy is as a forward looking Taylor rule

30) $$r_t = \overline{rr}_t + \theta\, E_t\{\pi_{t+1}\}$$

with

31) $$\theta = 1 + \frac{\xi\sigma_0(1-\rho)}{\rho} > 1$$

We see immediately that for our benchmark case with σ_0 decreasing in γ, *in a more open economy the central bank needs to lean less against the wind for any given inflation shock. This is so even though the more open economy places a greater weight on inflation stabilization.* The intuition for this result is that for our benchmark case of $\sigma > 1$, the more open economy has a *flatter* IS curve which means that the central bank gets more bang out of every basis point.

$$y_t = \gamma(1 - \sigma^{-1}) s_t - \{(1-\rho)\sigma\}^{-1}(r_t - E_t\pi_{t+1})$$

In effect, a given rise in the real interest rate impacts aggregate demand through two channels, exports and domestic consumption. Under a Taylor rule, an inflation shock is met by a rise in the ex ante real policy rate and this induces a real appreciation and an improvement in the terms of trade.

It is important to recall that while there is a unique way to write the optimal policy rule as a function of the model's state variables $\{a_t, a^*_t, u_t, u^*_t\}$ there are several ways to express the policy rule in terms of endogenous variables so that (30) is by no means unique. For example, we can also write the optimal policy rule as

32) $$r_t = \overline{rr}_t + (\theta - 1)E_t\pi_{t+1} + \rho\{\Delta e_t - (\Delta y_t - \Delta y^*_t)\}$$

where we assume for expositional convenience that $\pi^* = 0$. Thus , while in our open economy framework it is possible to write the optimal policy rule without explicitly including the nominal exchange rate, there is an equivalent way to express the rule that includes the nominal exchange rate of depreciation, as well as the growth rate differential between the home and foreign country. The intuition is as follows. A nominal rate of depreciation equal to the growth differential will produce a terms of trade adjustment that clears the global goods market without any change in domestic prices. If the rate of depreciation exceeds the growth differential, that means there is positive domestic inflation and the central bank should lean against it. Just for completeness, we note that it is possible to write the optimal policy rule without including domestic inflation at all!

33) $$r_t = \overline{rr}_t + \theta\rho\{\Delta e_t - (\Delta y_t - \Delta y_t^*)\}$$

where the coefficient $\theta\rho$ satisfies the Taylor Principle for our benchmark case of $\sigma > 1$.

Finally, consider the covariance between inflation surprises and the nominal exchange rate. CGG (2002) show that in the symmetric two country version of the model, under optimal monetary policy, *bad news about inflation is good news for the nominal exchange rate.* That is, when there is a shock that pushes inflation up, the nominal exchange rate under optimal monetary policy appreciates on impact, even though in the long run, with a unit root in the price level, the exchange rate must depreciate. This is because the inflation shock induces the central bank to raise the real interest rate today *and in the future* , and the expected path of higher than steady state real interest rates can be sufficient to trigger a nominal appreciation. This is easiest to see in the border line case of $\sigma = 1$ and constant productivity. We then have $s_t = -\frac{(\theta - 1)\rho\pi_t}{1-\rho}$. Bad news about inflation will be good news for the exchange rate if and only if $\frac{(\theta - 1)\rho\pi_t}{1-\rho} > 1$. Thus, for an arbitrary Taylor rule coefficient θ if shocks to inflation are sufficiently persistent, bad news about inflation will be good news for the exchange rate. However under optimal policy, from (31) we have

34) $$s_t = -\xi\sigma_0\pi_t$$

with $\xi\sigma_0 > 1$ so that bad news about inflation is good news for exchange the exchange rate under optimal policy. Clarida and Waldman (2006) generalize this result to allow for endogenous inflation persistence. They also show empirically that for inflation targeting countries, bad news about inflation is indeed good news for the exchange rate in that announcements of higher than expected inflation on the date inflation statistics are released are significantly correlated with appreciations of the exchange rate after the announcement.

6. Concluding Remarks

We have shown that starting from an explicit, two country optimizing framework yields a number of specific predictions with regards to the effect of openness on the building blocks of a standard macro model – the IS and AS curves - as well as for the specification of optimal monetary policy decision (Taylor) rules in the open economy and the effectiveness of monetary policy under these rules. Our main findings were as follows:

First, there will in general be a *spillover from foreign output to potential domestic output*. This is an area of research that deserves far more attention than it gets today. This paper has highlighted one such channel which is the decline in the flexible price shadow value of domestic employment, and thus the decline in domestic potential output, that occurs in response to income effect of the terms of trade improvement that follows from a rise in foreign output. The more open is the economy, the larger is this spillover to domestic potential output from foreign output.

Second, there will in general be a *spillover from foreign output growth to the domestic neutral real interest rate*. In our benchmark case this spillover is positive so faster foreign growth, whether due to potential growth or the business cycle, raises the neutral domestic real interest rate. Moreover, the more open the economy is, the larger is this effect of foreign growth on the domestic real interest rate and the smaller is the effect of domestic growth on the domestic real interest rate.

Third, we showed that *a more open economy has a flatter IS curve,* so that the central bank gets more bang out of every basis point buck by which it changes the policy rate in an open economy than in an otherwise identical closed economy. This is because there are two channels in the open economy through which a change in the policy rate can impact aggregate demand, through its effect on the growth of the consumption index and through its effect on the terms of trade and thus the amount of consumption that is filled by domestic production. However intuitive this sounds, this result – like most of the others in this paper - is not baked in the cake. Indeed, for the case $\sigma < 1$, a more open economy has a steeper IS curve.

Fourth, we showed that *a more open economy has a flatter Phillips curve* so that there is a smaller reduction in domestic inflation for any given decline in domestic output.

Fifth, Clarida, Gali, and Gertler (2002) prove and we discuss that *a more open economy places a smaller weight on output stabilization and thus a larger weight on inflation stabilization in the appropriately derived quadratic approximation to the social welfare function.*

Sixth, we showed *that optimal monetary policy in the open economy can be written as a Taylor rule in the neutral real interest rate and expected domestic inflation*.

Seventh, we showed that *in a more open economy the Taylor rule coefficient on expected inflation is small, so that the central bank needs to lean less against the wind for any given inflation shock.* The intuition for this result is that the more open economy has a *flatter* IS curve which means that the central bank gets more bang out of every basis point buck, and this is reflected in the policy rule.

Eighth, while a Taylor rule is one way to write the optimal policy rule, *the optimal policy rule can also be written as an augmented Taylor rule that includes the rate of nominal exchange rate depreciation and the home foreign growth differential*.

Ninth, there is a presumption that, under optimal monetary policy, *bad news about inflation will be good news for the exchange rate* as documented in Clarida and Waldman (2006).

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