International Spill-over Effects and Monetary Policy Activism*

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Abstract

This paper examines how the preferences of a large economy’s central bank affect the trade-off between output and inflation volatility faced by the central bank of a small open economy by analysing the impact of a global cost-push shock. We demonstrate that under the assumption of producer currency pricing, the trade-off faced by the small open economy is likely to worsen as the foreign central bank becomes more focused on output stabilisation relative to inflation stabilisation; but the opposite is true in the case of local currency pricing.

Keywords: Small open economy, Policy trade-offs, Producer vs local currency pricing

JEL codes: E58, F41, F42

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1 Introduction

Over the period from about 2003 to 2008 the world experienced a sharp rise in the price of oil and other commodities, which put upward pressure on inflation across the globe as discussed by IMF (2008). Moreover, as documented by IMF (2009), output growth has contracted sharply in most countries following the adverse shock to the international financial system, which gained momentum during the course of 2008. This has posed challenges for central banks that on the one hand wish to stimulate growth while at the same time ensuring that inflation expectations remain anchored. Since central banks differ in terms of their preferences for stabilising output and inflation, monetary policy has responded differently to this challenge across countries.1

This paper examines how the preference of a large 'Foreign' economy's central bank affects the trade-off between output and inflation volatility faced by a central bank of a small open 'Home' economy. In order to study this question we use a New Keynesian model of a small open economy along the lines of Gali and Monacelli (2005) and De Paoli (2009). Suppose that the two countries are hit by a global cost-push shock: does it make it harder for the Home central bank to bring down inflation without causing large output falls when the Foreign central bank is 'dovish', and is hesitant to bring down inflation quickly? We demonstrate that the impact of a more ‘dovish’ Foreign central bank on the trade-off faced by the Home central bank depends on two key factors: the substitutability between goods produced in Home and Foreign, and the currency in which exports are denominated. The substitutability between goods determines the extent to which demand switches between Home and Foreign goods following a change in relative prices, and it determines how Home labour supply responds to fluctuations in the terms of trade. The choice of invoicing currency is important since it determines how Foreign monetary policy affects Home's terms of trade and hence labour supply.

The paper is organised as follows. Section 2 outlines the small open economy model used for the analysis. Section 3 discusses the key results of our analysis. Under the assumption of producer currency pricing (PCP, i.e. products are priced in the currency of the exporters), we show that as the Foreign central bank becomes more dovish – i.e. it places less weight on stabilising inflation relative to stabilising output in its objective function – the Home central bank is likely to be facing a more adverse inflation-output trade-off. But under local currency pricing (LCP, i.e. products are priced in the currency of consumers), assuming that the prices set by Home exporters are sufficiently sticky, the Home central bank's trade-off improves as the Foreign central bank becomes more dovish. Section 4 concludes.

2 The model

The analysis is conducted within a dynamic two-country general equilibrium model, which consists of ‘Home’ (indexed by \(H\)) and ‘Foreign’ (indexed by \(F\)), with Foreign variables denoted by *. Representative households in each country supply labour to monopolistically competitive firms producing differentiated goods, and consume

1 The differences in monetary policy responses may also reflect the fact that the shocks have not affected all countries to the same extent.
goods produced both at home and abroad. Wages are assumed to be fully flexible, but prices are assumed to be sticky as in Calvo (1983). All goods are tradable, but the existence of a home bias in preferences allows us to calibrate the degree of openness of the Home country. We adopt the approach of De Paoli (2009), which first solves for the equilibrium of the two-country model, and then takes the limit of the Home’s size to zero. The model is in the class of the cashless-limiting economies, see e.g. Woodford (2003). Here, we only present a summary of the model’s equilibrium conditions in log-linearised form. For the derivation of these equations, see Appendix A of De Paoli (2009).

Under the assumption of producer currency pricing, the equilibrium conditions for the small open ‘Home’ economy can be characterised by the equations below, where all variables are expressed in log deviations from steady state, i.e. \( \hat{X} = \frac{X - X^*}{X^*} \).

\[
\begin{align*}
\hat{\pi}_{H,t} &= k(pC_t + \eta H_t + \lambda \hat{H}_t + \hat{\mu}_t) + \beta \hat{\pi}_{H,t+1}, \\
\hat{Y}_t &= (1 - \lambda)\hat{C}_t + \lambda \hat{C}_t^* + \theta \lambda (2 - \lambda) \hat{T}_t, \\
\hat{C}_t &= \hat{C}_t^* \frac{1}{\rho} \hat{R}_S, \\
\hat{\pi}_t &= (1 - \lambda)\hat{\pi}_{H,t} + \lambda \hat{\pi}_{F,t}, \\
\hat{\pi}_{F,t} &= \hat{\pi}_t^* + \Delta \hat{S}_t, \\
\Delta \hat{R}_S &= \Delta \hat{S}_t + \hat{\pi}_t^* - \hat{\pi}_t, \\
\Delta \hat{T}_t &= \Delta \hat{S}_t + \hat{\pi}_t^* - \hat{\pi}_t^H, \\
\hat{T}_t &= \frac{1}{1 - \lambda} \hat{R}_S.
\end{align*}
\]

The variables \( \hat{C}_t \) and \( \hat{C}_t^* \) denote Home and Foreign consumption, \( \hat{Y}_t \) denotes Home output, \( \hat{T}_t \) represents the terms of trade, \( \hat{R}_S \) denotes the real exchange rate and \( \Delta \hat{R}_S \) denotes its change from one period to the next (a rise in \( \hat{R}_S \) indicates a Home depreciation). Similarly \( \Delta \hat{S}_t \) represents the change in the nominal exchange rate. \( \hat{\pi}_t \) and \( \hat{\pi}_t^* \) denote Home and Foreign consumer price inflation (the latter is defined by (9) below), and \( \hat{\pi}_t^H \) denotes Home producer price inflation. The exogenous global cost-push shock is captured by \( \hat{\mu}_t \), which is the wedge between marginal utility of consumption and marginal disutility of production both in Home and Foreign. This is an inefficient shock which increases inflation both in Home and Foreign and creates a trade-off for the central banks between stabilising output gap and inflation.\(^2\) The remaining parameters and the baseline calibration used in Section 3 are outlined in Table 1 below.

\( (\text{Insert Table 1}) \)

Equations (1) and (2) characterise Home aggregate supply and demand, respectively. Home inflation depends not only on real marginal cost but also on the terms of trade. Condition (3) holds under the assumption of

\(^2\)Note that in an open economy environment the trade-off between inflation and output gap arises irrespective of the source of the shock (see De Paoli (2009)).
complete financial markets, which allows optimal risk-sharing between Home and Foreign consumers. Consumer price inflation (4) is a weighted sum of Home producer price inflation $\pi_{H,t}$ and import price inflation $\pi_{F,t}$, which is the sum of Foreign producer price inflation and the change in the nominal exchange rate (as can be seen in (5)). The system is closed by defining the change in the real exchange rate (6) as the sum of the change in the nominal exchange rate and the difference between Foreign and Home consumer price inflation, and the change in the terms of trade (7) as the sum of the change in the nominal exchange rate and the difference between Foreign and Home producer price inflation. This implies that the terms of trade will be proportional to the real exchange rate, see (8).

Since Foreign households consume a minimal amount of Home goods, Foreign consumer price inflation coincides with producer price inflation, and the Foreign economy is characterised by a familiar ‘closed economy’ New Keynesian Phillips Curve:

$$\hat{\pi}_t^* = \kappa^*((\rho + \eta)\hat{Y}_t^* + \hat{\mu}_t) + \beta\hat{\pi}_{t+1}^*$$

(9)

where $\hat{\pi}_t^*$ denotes Foreign consumer price inflation, $\hat{Y}_t^*$ denotes Foreign output, and $\hat{\mu}_t$ is the global cost-push shock which hits both Foreign and Home.

3 Results

3.1 Analytical results

To illustrate how the Home central bank’s policy trade-off depends on Foreign central bank’s preference, we first analyse the model under a set of assumptions that enables us to derive an analytical solution. To do this, we assume that the central banks stabilise a weighted average of the squared deviations of producer price inflation and output from steady state.\(^3\) The loss functions of the Home and Foreign central banks, respectively, are given by:

$$L = \sum_{t=0}^{\infty} \beta^t \left( \hat{\pi}_{H,t}^2 + \delta\hat{Y}_t^2 \right) ; \quad L^* = \sum_{t=0}^{\infty} \beta^t \left( \hat{\pi}_t^2 + \delta^*\hat{Y}_t^2 \right)$$

$\delta$ and $\delta^*$ are the weights that the Home and Foreign central banks place on output stabilisation relative to inflation stabilisation. A central bank with a low $\delta$ will be characterised as ‘hawkish’, whereas a central bank with a high $\delta$ is said to be ‘dovish’. Since the Home economy is assumed to be of size zero, there is no potential for strategic interaction between the two central banks. The central banks are assumed to be unable to credibly commit to future actions, i.e. the model is solved under discretion. Later we also solve the policy problem under the assumptions that the central banks can credibly commit to future actions, and that they stabilise consumer price inflation rather than producer price inflation.\(^4\) Finally, we also assume for now that the cost-push shocks, $\hat{\mu}_t$, are iid.

\(^3\)Notice that since we study only inefficient shocks, there is no distinction between the variance of output and the variance of the welfare-relevant output gap.

\(^4\)See Woodford (2003) for a discussion of optimal policy under discretion versus commitment.
Under these assumptions, Foreign output and inflation are given by:

\[ \hat{Y}_t^* = \phi_y \hat{\mu}_t \quad ; \quad \pi_t^* = \phi_{\pi} \hat{\mu}_t \quad (10) \]

where \( \phi_y^* = -\frac{k^2(\rho+n)}{k^2(\rho+n) + \delta^*} < 0 \) and \( \phi_{\pi}^* = \frac{\delta^*}{k^2(\rho+n) + \delta^*} > 0 \). (10) shows that a mark-up shock reduces Foreign output and increases inflation; and the volatility of output falls and the volatility of inflation rises as the Foreign central bank becomes more dovish (\( \delta^* \) rises).

In the Home economy, output and producer price inflation are functions of Foreign output, the mark-up shock and the policy parameters:

\[ \hat{Y}_t = \phi_y (\rho - n_{rs}) \hat{Y}_t^* + \phi_y \hat{\mu}_t \quad (11) \]

\[ \hat{\pi}_{H,t} = \phi_{\pi} (\rho - n_{rs}) \hat{Y}_t^* + \phi_{\pi} \hat{\mu}_t \quad (12) \]

where \( \phi_y = -\frac{k^2(n+n_{rs})}{k^2(n+n_{rs}) + \delta} < 0 \), \( \phi_{\pi} = \frac{\delta}{k^2(n+n_{rs}) + \delta} > 0 \), and \( n_{RS} = \frac{\rho}{(\mu-\lambda)(\lambda^2-1)+I} \). It follows from (11) and (12) that the direct effect of the cost-push shock on Home is similar to the effect on Foreign: output falls and inflation rises. But in addition, Home is also influenced by Foreign monetary policy, so that \( \hat{Y}_t^* \) enters into (11) and (12).

The direction in which Foreign policy affects Home output and inflation depends critically on whether Home and Foreign goods are what in technical terms are referred to as substitutes or complements in the utility, see e.g. Corsetti and Pesenti (2001). Home and Foreign goods are substitutes (complements) in the utility, i.e. the marginal utility of one good decreases (increases) with the increase in consumption of another good, when the intratemporal elasticity of substitution is higher (lower) than the intertemporal elasticity of substitution (analytically when: \( \rho > 1 \) (\( \rho < 1 \))). It can easily be shown that

\[ \rho > n_{rs} \iff \rho \theta > 1 \quad (13) \]

It follows from (11), (12) and (13) that when the goods are substitutes in the utility, a decrease in \( \hat{Y}_t^* \) reduces \( \hat{\pi}_{H,t} \) and increases \( \hat{Y}_t \). Since Foreign output falls more in response to a cost-push shock as the Foreign central bank becomes more hawkish, output falls by less and inflation rises by less in response to the cost-push shock in the Home economy. By contrast, if the goods are complements in the utility, a more hawkish Foreign central bank increases the volatility of Home output and inflation.

This result has a very intuitive explanation. As studied by Corsetti and Pesenti (2001), a Foreign monetary tightening has two opposing effects on the demand for Home goods and hence on Home output. The demand for Home goods tends to fall as Foreign consumption decreases (aggregate demand effect). On the other hand, a Foreign tightening also leads to a real depreciation of the Home currency and therefore to a terms of trade deterioration. The resulting fall in the foreign price of Home exports increases demand for Home goods, and so its output increases (expenditure-switching effect). Which of these two effects dominates depends on whether Home and Foreign goods are complements or substitutes in the utility. When Home and Foreign goods are substitutes in the utility, the expenditure-switching effect dominates because even a small shift in the terms of
trade induces aggregate demand to switch from Foreign goods to Home goods. Consequently, world demand for Home goods increases and so does Home output. The impact of a Foreign tightening on Home inflation can be understood by considering the relationship between real marginal cost and the terms of trade (see Benigno and Benigno (2006)). When the goods are substitutes in the utility, the terms of trade deterioration makes Home workers feel poorer and want to work harder, which pushes down on real wages and inflation.\(^5\)

Our result is related to the result by Benigno and Benigno (2008). In a two-country model with cost-push shocks, they study how the objectives of the national central banks should be designed to maximise the combined welfare of the households in both countries. They show that the optimal objective of each central bank can be represented as a weighted sum of domestic producer price inflation and the output gap, and the weights attached to each of the variables depend on the substitutability of Home and Foreign goods. If the goods are substitutes the central banks should respond more to fluctuations in domestic inflation relative to the closed economy version of the model, whereas the opposite is the case if the goods are complements. This reflects the fact that when the goods are substitutes, a hawkish policy of one country improves welfare of the other country.

3.2 Numerical results

We now modify the assumptions to make the model more realistic. First, we assume that the global cost push shock, \( \hat{\mu}_t \), follows an AR(1) process. We also assume that central banks stabilise consumer price inflation rather than producer price inflation, i.e. the loss functions are given by:

\[
L = \sum_{t=0}^{\infty} \beta^t \left( \hat{\pi}_t^2 + \delta\hat{Y}_t^2 \right) \quad ; \quad L^* = \sum_{t=0}^{\infty} \beta^t \left( \hat{\pi}_t^*2 + \delta^*\hat{Y}_t^*2 \right)
\]

(14)

As argued by Svensson (2003), (14) captures well the objectives of an inflation targeting central bank. Finally, we now assume that central banks can credibly commit to future actions. Since the model cannot be solved analytically under these assumptions, we calibrate the model using the parameter values outlined in Table 1. The policy trade-off faced by the Home central bank is summarised in the form of Taylor frontiers which plot the combinations of inflation and output volatility that can be achieved by the Home central bank for given preferences of the Foreign central bank.

3.2.1 Producer currency pricing

Case 1: Goods substitutes in the utility We first assume that Home and Foreign goods are substitutes in the utility \((\rho \theta > 1)\) by setting \( \theta = 3 \) and \( \rho = 2.5 \). The persistence of the global cost-push shock \( \hat{\mu}_t \) is assumed to be 0.99. The remaining parameters are calibrated according to Table 1.

\((\text{Insert Figure 1})\)

Figure 1 plots the Home Taylor frontiers for different values of \( \delta^* \). The solid line represents the Home Taylor frontier when the Foreign central bank is most ‘hawkish’ \((\delta^* = 0.05\), which corresponds to the weight in the

\(^5\)Also see Woodford (2007) for a discussion of how foreign variables affect domestic labour supply in an open economy.
utility-based loss function of the closed economy of Woodford (2003)), whereas the dashed line represents the Home Taylor frontier when the Foreign central bank is most ‘dovish’ (the weight on output gap in its loss function $\delta^* = 5$). The Home central bank chooses a point on a given Taylor curve depending on its preference, $\delta$: as the Home central bank becomes more dovish (i.e. $\delta$ increases), its chosen point will move along each Taylor curve from the left to the right. The dotted line represents variances of output and CPI inflation implied by $\delta = 1$.

Figure 1 shows that as the Foreign central bank becomes more dovish (i.e. $\delta^*$ increases), the Taylor frontier facing the Home country shifts out: so for a given cost-push shock, the Home central bank has to tolerate greater inflation and output volatility. This confirms that results from the previous section also hold in the more realistic version of the model. With consumer price inflation in the loss function the beneficial effect of a Foreign tightening on Home inflation mentioned in the previous section is partly offset by a Home currency depreciation, which pushes up on the price of imports. But when the goods are substitutes in the utility, exchange rate movements will tend to be small. In quantitative terms, if we increase $\delta^*$ from 1 to 2, the variance of Home inflation increases by 27% and the variance of Home output by 15% under the assumption that $\delta = 1$.

Case 2: Goods complements in the utility Now assume instead that $\theta = 0.3$ and $\rho = 2.5$, so that the Home and Foreign goods are complements in the utility ($\rho \theta < 1$). Figure 2 plots the Home Taylor frontier under this assumption: as before, the solid line represents the case when $\delta^* = 0.05$ while the dashed line represents the case when $\delta^* = 5$. Figure 2 shows that when goods are complements in the utility, the result reverses: as the Foreign central bank becomes more dovish (i.e. $\delta^*$ increases), the Home Taylor frontier now shifts in, thus improving the trade-off facing the Home central bank. So in this case the Foreign monetary policy tightening amplifies the cost-push shock from Home’s perspective, confirming the analytical results from the special case above. The existing literature, however, suggests that the Home and Foreign goods are more likely to be substitutes rather than complements in the utility: the intertemporal elasticity of substitution is usually assumed to be less than 1. Moreover, Obstfeld and Rogoff (2000b)’s survey of various trade studies suggests that goods are rather substitutes with elasticities in the neighbourhood of 5 to 6.

3.2.2 Local currency pricing

Producer currency pricing is a useful benchmark, and it is strongly advocated by Obstfeld and Rogoff (2000a): it implies that a nominal depreciation is associated with a terms of trade deterioration, which is consistent with the data. But as pointed out by Mussa (1986) and Devereux and Engel (2007), the link between changes in exchange rates and changes in national consumer prices is weak empirically. This contradicts one of the key implications of producer currency pricing. We therefore repeat our analysis under the assumption that prices
are sticky in the currency of the consumer (local currency pricing), using a stripped-down version of the model developed by Lipinska (2008).

Since the Foreign country is essentially a closed economy, the equilibrium condition of Foreign remains the same as (9). The Home economy under local currency pricing is characterised by the following equilibrium conditions:

\[ \pi_{H,t} = k (\rho \tilde{C}_t + \eta \tilde{Y}_t + \lambda \tilde{T}_t + \tilde{\mu}_t) + \beta \tilde{\pi}_{H,t+1}, \]
\[ \pi^{*}_{H,t} = k (\rho \tilde{C}_t + \eta \tilde{Y}_t - \tilde{R} \tilde{S}_t + \tilde{T}_t^* + \tilde{\mu}_t) + \beta \tilde{\pi}^{*}_{H,t+1}, \]
\[ \tilde{\pi}_t = (1 - \lambda) \tilde{\pi}_{H,t} + \lambda \tilde{\pi}_{F,t}, \]
\[ \Delta \tilde{R} \tilde{S}_t = \Delta \tilde{S}_t + \tilde{\pi}_t - \tilde{\pi}_t, \]
\[ \tilde{T}_t - \tilde{T}_{t-1} = \tilde{\pi}_{F,t} - \tilde{\pi}_{H,t}, \]
\[ \tilde{T}_t^* - \tilde{T}_{t-1} = \pi^{*}_{F,t} - \tilde{\pi}^{*}_{H,t}, \]
\[ \Delta \tilde{D} \tilde{O} \tilde{T}_t = \tilde{\pi}_{F,t} - \Delta \tilde{S}_t - \tilde{\pi}^{*}_{H,t}. \]

Since the law of one price does not hold, the relative price of Home to Foreign goods differs in the two countries. Following Benigno (2004) we define \( T_t \) and \( T_t^* \) to represent the price of the imported good relative to domestically-produced good, expressed in the local currency. Since Home producers can charge different prices in Home and Foreign markets, there are two separate Phillips curves for Home-produced goods sold at home (15) and abroad (16). Home inflation and Home export inflation both depend on real marginal costs and on the relative price of Home to Foreign goods in local currency. Moreover, Home export inflation also depends on the real exchange rate, since revenues of Home exporters are denominated in Foreign currency and costs are in Home currency. Similarly, as Foreign producers also charge different prices in the two countries, we obtain a separate inflation equation for imports in the Home country, \( \tilde{\pi}_{F,t}, (17) \), which depends not only on Foreign real marginal cost but also on the price of Foreign exports relative to Home goods and on the real exchange rate. The difference in relative prices when denominated in Home and Foreign currency is also reflected in the aggregate demand equation (18).

Finally, under local currency pricing the real exchange rate and the terms of trade are not proportional (see (20)-(24)). In fact, a real exchange rate depreciation is likely to be associated with a terms of trade improvement when prices are sticky in local currency, as it raises the Home currency price of exports but leaves import prices unchanged.\(^6\) This is indeed the case in the benchmark calibration. The expenditure-switching effect of an

\(^6\)Note that the invoicing currency matters in our analysis because prices are assumed to be sticky in local currency. The assumption of price stickiness ensures that Home’s terms of trade shifts in the opposite directions under PCP and LCP in response to a Foreign monetary tightening. If prices are flexible, then the two scenarios of PCP and LCP are equivalent.
exchange rate depreciation is therefore reduced relative to the model with producer currency pricing (see also Betts and Devereux (2000)). A depreciation of the real exchange rate also increases the revenues of Home exporters, thus increasing Home demand for Home goods, boosting Home wages and leading to inflationary pressures in this sector.

We study the model under the assumption of persistent cost-push shocks, consumer price inflation in the loss function and monetary policy under commitment. The Taylor curves for $\rho \theta > 1$ ($\rho = 2.5$, $\theta = 3$) are illustrated in Figure 3. As before, the solid line represents the case when $\delta^* = 0.05$ (Foreign central bank is hawkish) while the dashed line represents the case when $\delta^* = 5$ (Foreign central bank is dovish).

Figure 3 shows that the Taylor frontier facing Home now shifts inward as the Foreign central bank becomes more dovish, rather than outward, as was the case with producer currency pricing. As the Foreign central bank tightens to counter the cost-push shock, Foreign demand for Home goods falls, reducing Home output and export inflation. In addition, Foreign tightening also causes a real (and nominal) depreciation of Home currency, an improvement in the terms of trade for Home, and a rise in revenues for Home exporters. This causes Home workers to reduce their labour supply (income effect) which increases Home real wages and inflation. Since Foreign tightening amplifies the two direct effects of a cost-push shock at Home – increased inflation and reduced output – a more dovish Foreign central bank allows the Home central bank to achieve lower inflation and output volatility. To give an estimate of the size of the effect: if we increase the Foreign central bank’s weight on output stabilisation from 1 to 2, we reduce the variance of inflation by about 13% and the variance of output by 6% under the assumption that $\delta = 1$.

### 3.2.3 Sticky wages (producer currency pricing)

The effect of changes in the terms of trade on labour supply is an important channel of transmission of monetary policy spillovers from Foreign to Home in our model. As a robustness check, we modify the model of producer currency pricing to introduce monopolistically competitive households that set nominal wages in staggered contracts as in Erceg et al. (2000). As shown in Figure 4, sticky wages do not change the ranking of Taylor frontier but greatly reduce inflation volatility, because the shift in labour supply induces a much smaller change in real wages and thus attenuates its effect on Home inflation. When the Home central bank places equal weight on stabilising inflation and output ($\delta = 1$, represented by the dotted line), Home output is also much more stable than under flexible wages for any value of $\delta^*$. But if Home places only small weight on output stabilisation (as in Woodford (2003)’s closed economy, where $\delta = 0.05$), the variance of Home output is still strongly affected by the preferences of the Foreign central bank.

(Insert Figure 4)
4 Conclusions

A key conclusion emerging from our analysis is that depending on the invoicing currency of exports and the degree of substitutability between Home and Foreign goods, a more ‘dovish’ central bank in the large economy could either improve or worsen the inflation-output trade-off faced by the small economy. Under PCP, the trade-off faced by the Home central bank is likely to worsen as the Foreign central bank becomes ‘dovish’ and more focused on output stabilisation rather than inflation stabilisation. However, the opposite is true under LCP.

We have analysed this issue using a model of sticky prices and flexible wages in an environment of complete markets. We note that the terms of trade channel, which leads to shifts in Home labour supply and wages in response to Foreign monetary policy as well as to shifts in the demand for Home relative to Foreign goods, is the key driver of our results. A lower degree of financial market integration, which prevents consumers increasing consumption by borrowing from abroad, or the presence of sticky wages would reduce the importance of the terms of trade channel in affecting the trade-off faced by the Home central bank.

References


5 Tables and Figures
Table 1: Model parameters

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<th>Parameter</th>
<th>Value</th>
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<td>Intertemporal elasticity of substitution ($\rho^{-1}$)</td>
<td>Scenario dependent</td>
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<tr>
<td>Intratemporal elasticity of substitution ($\theta$)</td>
<td>Scenario dependent</td>
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<tr>
<td>Frisch elasticity of labour supply ($\eta^{-1}$)</td>
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<td>Degree of openness ($\lambda$)</td>
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<td>Subjective discount factor ($\beta$)</td>
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<td>Elasticity of substitution across the differentiated products ($\sigma$)</td>
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<tr>
<td>Probability of not being able to reset price ($\alpha$)</td>
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</tr>
</tbody>
</table>

\[
k = (1 - \alpha \beta) (1 - \alpha) / \alpha (1 + \sigma \eta)
\]

\[
k^* = (1 - \alpha^* \beta) (1 - \alpha^*) / \alpha^* (1 + \sigma \eta)
\]

Figure 1: Home Taylor frontier under producer currency pricing and $\rho \theta > 1$
Figure 2: Home Taylor frontier under producer currency pricing and $\rho \theta < 1$

Figure 3: Home Taylor frontier under local currency pricing and $\rho \theta > 1$
Figure 4: Home Taylor frontier with sticky wages under producer currency pricing and $\rho \theta > 1$. 

\[ \delta^* = 0.05 \]
\[ \delta^* = 1 \]
\[ \delta^* = 2 \]
\[ \delta^* = 3 \]
\[ \delta^* = 4 \]
\[ \delta^* = 5 \]