On the Reasons Behind Fear of Floating: Pass-through Effects vs. Contractionary Depreciations

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Abstract

Based on a simple open economy framework, this analysis rationalizes the existence of "fear of floating"-type responses and uncovers some important implications about to role of pass-through effects and contractionary depreciations. By examining how the optimal monetary response varies when altering the effects of the real exchange rate on output and inflation, this analysis reveals the existence of non-linearities when we allow for contractionary depreciations. In particular, an increase in the pass-through coefficient may well imply the need to tighten or relax the monetary stance depending on how contractionary real depreciations are. These findings may help to understand the empirical results where pass-through effects have failed to appear significant when accounting for low exchange rate and high interest rate variability. They also reveal the complications that arise when conducting monetary policy in a partially dollarized economy.

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1. Introduction

If we were to use the Mundell-Fleming model to prescribe an exchange rate regime for emerging markets (EMs), we would probably choose a flexible one. In fact, most of these countries can be characterized as small, open economies, subject to frequent and large real external shocks. Under this scenario, a flexible exchange rate should provide the necessary insulation from external disturbances while allowing an independent domestic monetary policy to react in the event of an internal shock.

While the increasing number of EMs officially classified as floaters seems to agree with the above wisdom, a closer exploration of the empirical evidence reveals that in many of these economies the exchange rate is not allowed to fully accomplish its role as an external shock absorber. In other words, and after controlling for the size and frequency of these shocks, many EMs fail to exhibit enough relative exchange rate volatility to regard them as having a flexible regime. In fact, tight monetary policies aimed at preventing sharp depreciations seem to be a common practice among many official floaters and a typical symptom of what has been called "fear of floating".

As carefully documented by Calvo and Reinhart (2000a), economies characterized by this "fear of floating" not only exhibit mild exchange rate fluctuations but also evidence high reserve and interest rate volatility. As an example of their findings, consider the United States and Japan as a benchmark for "true floaters". According to their results, the probability that the monthly variation of the nominal exchange rate falls within a plus/minus 2.5% band in these countries is 0.587 and 0.612, respectively. Contrary to what one would expect, for a sample of 10 emerging economies officially classified as "free floaters"[1] this probability rises, on average, to 0.764. If we now consider nominal interest rates, the probability that their monthly variation falls within a plus/minus 25

[1] The selected sample includes Bolivia, India, Kenya, Mexico, Nigeria, Peru, Philippines, South Africa, Uganda and Venezuela. The periods considered are those in which these countries were classified as having a floating exchange rate regime by the IMF.

basis points band for the benchmark floaters is 0.597 and 0.679, while this same figure for the selected EMs falls to 0.294.

These findings provide strong evidence in favour of the existence of active interest rate shifts aimed at smoothing exchange rate fluctuations in many countries who officially hold a flexible regime. In fact, these conclusions are reinforced by the presence of a positive correlation between the exchange rate and domestic interest rates.

Presented with this evidence[2], a natural question is why. Why do we observe so low exchange rate volatility in many official floaters who are subject to large and frequent external shocks. Or, from the standpoint of monetary policy objectives, why are these countries trying to smooth exchange rate fluctuations. In fact, the main objective of this essay is to explore some of the reasons behind what Calvo and Reinhart describe as an epidemic case of "fear of floating". For this, the rest of the paper is organized as follows. Section 2 presents a brief survey of the reasons already identified in the literature. On the basis of this evidence, section 3 introduces a simple open economy framework to address the relative importance of what current wisdom regards as two important causes: high pass-through coefficients and the presence of contractionary real depreciations. Finally, section 4 summarizes the main findings and suggests some avenues for future research.

2. The reasons behind the fear

This section will focus on some of the characteristics that many official emerging floaters exhibit and that are usually invoked to rationalise the findings described above.

2.1 Lack of credibility

Since "fear of floating" seems to be a widespread characteristic among EMs, Calvo and Reinhart (2000a, 2000b) address its causes suggesting another common feature of these

[2] See also Levy-Yeyati and Sturzenegger (1999). For evidence on the Peruvian "fear of floating" see Castro and Morón (2000).

economies: a lack of credibility which could easily lead to unstable expectations.

With a simple Cagan-type model of exchange rate determination and setting money supply as the policy instrument, they show that (under circumstances of poor credibility), the monetary authority will choose to stabilize the exchange rate rather than the interest rate. They argue that if (expected) currency depreciation threatens to rise the domestic interest rate, the monetary expansion required to stabilize it could undermine credibility. Moreover, under this scenario, any attempt to smooth the interest rate could be itself compromised due to exacerbated expectations about the future path of the exchange rate. The natural consequence is that the central bank will choose to stabilize the exchange rate via a tight monetary stance that will, in turn, lead to a higher interest rate[3] (a *pro-interest-rate-volatility* bias, as described by Calvo and Reinhart). This behaviour, consistent with the need to prevent expectations from becoming too unstable in an environment of poor credibility, will lead to lower exchange rate and higher interest rate variability.

2.2 Pass-through considerations

If inflation is a major concern of monetary authorities (as dictated by a standard loss function), the need to smooth out exchange rate fluctuations is a natural consequence in an economy where this variable has a significant effect on prices. According to Calvo and Reinhart (2000b), pass-through from exchange rate to prices can be regarded as another feature of EMs. Not only was this causality found statistically significant in 43% of the cases for EMs (versus 13% for developed economies), but the average pass-through was also four times as large in the first group.

[3] This explanation is particularly appealing to describe the behaviour of the Peruvian Central Bank in the aftermath of the Russian and Brazilian crises. One day after officers from the Ministry of Economy revealed to local bankers that their main concern was not the exchange rate but the reduction of interest rates (probably relying on the possibility of reducing expected depreciation by allowing the current exchange rate to adjust), the Central Bank not only maintained its tight monetary stance but also performed the most significant single US$ selling operation of that period, in a clear attempt to stabilize the currency.

The positive relation between the exchange rate and inflation can be explicitly addressed when deriving an open economy Phillips curve from first principles. As shown by Razin and Yuen (2001), the real exchange rate emerges in the inflation equation via the effect of foreign prices and the nominal exchange rate on the aggregate price index. This index not only accounts for staggered price setting decisions of local monopolistic producers (like in a traditional closed economy Phillips curve) but also incorporates the price (in local currency) of foreign goods included in the domestic consumption bundle.

2.3 A contractionary depreciation

If domestic residents borrow in foreign currency and their income is denominated in local currency (generating large currency mismatches in the economy's balance sheet), a depreciation will exacerbate financial frictions and lead to a contraction of aggregate demand and output. Such an environment may create incentives for policymakers to avoid large depreciations and actively use the policy instrument to defend the exchange rate, incentives that can be understood if we rely on the inclusion of output fluctuations in the central bank's loss function. However, a tight monetary policy aimed at preventing these effects might have itself its costs in terms of output, so a complete stabilization of the exchange rate is not necessarily the best policy choice[4].

As described by Céspedes, Chang and Velasco (2000), the possibility of a contractionary depreciation can be formally addressed if we allow for agency costs associated to firms' external finance. In particular, and by assuming that capitalists finance their investment effort with their own net worth and foreign loans, imperfect information will imply the existence of a risk premium linked to the second source of funds (i.e. a divergence between the expected return on investment and the world interest rate). This risk premium is negatively related to firms' net worth which, in turn, is a decreasing function

[4] This issue will be formally addressed in the next section.

of the real exchange rate. In this manner, a real depreciation may have contractionary effects because of the negative impact of this risk premium on investment decisions. In particular, a real depreciation will increase the debt burden related to foreign loans, decreasing firms' net worth and, thus, increasing the cost of external finance via a positive shift in the risk premium.

The possibility of assigning contractionary effects to real depreciations will depend on the existence and strength of this "balance sheet" effect, which can be positively related to the degree of "liability dollarization"; again, another characteristic of EMs according to Calvo and Reinhart (2000b).

3. Pass-through vs. balance sheet effects: an analytical framework

After discussing the relationship between high pass-through coefficients, contractionary depreciations and "fear of floating", the main objective of this section is to determine how is the central bank's response to exchange rate innovations affected if we allow this variable to have different effects on output and inflation. The idea is to account for the relative importance of pass-through and "balance sheet" effects to explain "fear of floating"-type results and to rationalize this behaviour from the standpoint of a central bank with a typical loss function.

3.1 The model

In order to capture the key interactions between the macroeconomic variables involved, consider the following simple open economy setting:

$$\pi_t = E_{t-1}(\pi_t) + \lambda y_t + \gamma[q_t - E_{t-1}(q_t)] + u_t \tag{1}$$

$$y_t = E_t(y_{t+1}) - \sigma[i_t - E_t(\pi_{t+1})] + \delta q_t + g_t \tag{2}$$

$$q_t = -\theta[i_t - E_t(\pi_{t+1})] + v_t \tag{3}$$

where π_t is the inflation rate, y_t is output, q_t is the real exchange rate, and i_t is the nominal interest rate, all of them measured as deviations from their long run equilibrium levels. The disturbance terms u_t, g_t and v_t all obey AR(1) processes of the form:

$$
\begin{aligned}
u_t &= \varphi u_{t-1} + \varepsilon_{ut} \\
g_t &= \eta g_{t-1} + \varepsilon_{gt} \\
v_t &= \rho v_{t-1} + \varepsilon_{vt}
\end{aligned}
$$

where $0 \leq \varphi, \eta, \rho \leq 1$, and all three innovations are i.i.d random variables with mean zero and variances $\sigma^2_{\varepsilon i}$ $(i = u, g, v)$, respectively. All parameters are assumed positive, except d which will be allowed to take negative values.

Equation (1) is an open economy Phillips curve arising from staggered price setting by local monopolistic producers. As in Razin and Yuen (2001), the exchange rate has a positive impact on inflation through the unexpected component of the real exchange rate. In this sense, the parameter γ will be regarded as accounting for the degree of pass-through.

Equation (2) is an open economy IS curve. Together with the traditional negative effect associated to the real interest rate (which stems from the intertemporal substitution of consumption), this expression also accounts for the impact of the real exchange rate over aggregate demand. As mentioned before, in the following analysis the parameter governing this effect will be allowed to take both positive and negative values. Trying to determine what deep parameters are behind δ is beyond the scope of this exercise. As stressed above, the idea is to allow for contractionary real depreciations (which can be justified when the "balance sheet" effect -discussed in the previous section- dominates the more traditional substitution effect between foreign and domestic goods) and determine how is the central bank's response affected. Since the real exchange and interest rates are linked through equation (3) (described below), the overall sensitivity of output to the latter will be determined not only by σ (as in a closed economy setting) but also by the effect of the real exchange rate on aggregate demand. This type of relationship is addressed in Clarida, Galí and Gertler (2001) although their setting only allows for expansionary real depreciations, implying that the overall negative effect of the real interest rate on output is magnified when considering an open economy IS curve.

As in Ball (1998, 2000), equation (3) finally relates the evolution of the real exchange rate to the interest rate. Formally, one can think of (3) as capturing the relationship implied by an uncovered interest rate parity (UIRP) condition. If we define the nominal exchange rate and the world interest rate as e_t and i_t^*, respectively the log-approximation to the UIRP condition implies:

$$
\begin{aligned}
&i_t = i_t^* + E_t(e_{t+1}) - e_t \\
&i_t - E_t(P_{t+1}) + P_t = i_t^* - E_t(P_{t+1}^*) + P_t^* + E_t(e_{t+1} - P_{t+1} + P_{t+1}^*) - (e_t - P_t + P_t^*) \\
&i_t - E_t(\pi_{t+1}) = r_t^* + E_t(q_{t+1}) - q_t
\end{aligned}
$$

where r_t^* is the foreign real interest rate[5]. As mentioned above, the current real exchange and interest rates are linked through this condition, so we can think of the implicit policy instrument as being a combination of these two variables. For example, and if the foreign real interest rate experiences a positive shock, the central bank can choose to increase the local real interest rate, allow for a real depreciation (an increase in q_t), or both. Obviously, the optimal combination will depend on its preferences and on the relative effects of i_t and q_t on its target variables.

3.2 The policy objective and the optimal response

Following Clarida, *et. al.* (1999), the monetary authority seeks to minimize the fluctuations of both output and inflation around their target levels. Assuming that these targets are

[5] If we rely on this condition, the disturbance term v_t will need to account for shocks on the foreign real interest rate and on the expected path of the real exchange rate. Moreover, a strict UIRP condition would also imply that $\theta = 1$. However, this restriction will not be imposed just to keep the model as general as possible.

their long run equilibrium values, the central bank's optimisation problem will take the form:

$$\min_{i_t} E_t\left[\sum_{j=0}^{\infty}\tau^j(\alpha y_{t+j}^2+\pi_{t+j}^2)\right]$$

subject to the behavioural constraints (1), (2) and (3); where α is the relative weight on output deviations. This analysis will consider the case of a central bank acting under discretion ("optimal monetary policy without commitment"). Hence, it will choose the current interest rate by reoptimising every period. As in Clarida, *et. al.* (1999), this problem can be divided into two stages:

(i) Choose $\{y_t, \pi_t\}$ to minimize the static objective subject to the Phillips curve and (3). Thus, after differentiating with respect to y_t we obtain the following first order condition (FOC): $y_t = -\left[\frac{\lambda}{\alpha}+\frac{\gamma\theta}{\alpha(\sigma+\delta\theta)}\right]\pi_t$. As in Clarida, *et. al.* (1999), this condition implies that the central bank follows a "lean against the wind" policy: if inflation happens to be above target, the optimal response would be to contract demand below capacity by raising the interest rate, and vice-versa. However, in this case the FOC also accounts for the indirect effect of the interest rate over inflation via the real exchange rate. To gain a better understanding of this condition assume that $\lambda = 0$. In this case, it would seem that there is no gain in reduced inflation per unit of output loss, however, the ratio $\gamma\theta/(\sigma+\delta\theta)$ would still account for this due to the presence of the real exchange rate in the inflation equation. As in the original setting, a high value for α would reduce the impact on aggregate demand since this implies that the central bank is placing a larger weight on output fluctuations.

(ii) Working with the general forms:

$$\pi_t = \phi_1 u_t + \phi_2 u_{t-1} + \phi_3 v_t + \phi_4 v_{t-1} + \phi_5 g_t + \phi_6 g_{t-1} \tag{4}$$

$$i_t = \beta_1 u_t + \beta_2 u_{t-1} + \beta_3 v_t + \beta_4 v_{t-1} + \beta_5 g_t + \beta_6 g_{t-1} \tag{5}$$

and using the FOC and all the behavioural constraints, it is possible to solve for the parameters relating the interest rate to the lagged and contemporaneous disturbances through the method of undetermined coefficients.

From the expressions derived in (ii), it will be then possible to analyse how the central bank's response to an exchange rate innovation (ε_{vt}) will vary according to the degree of pass-through and the effect of real exchange rate movements on the output gap. In particular, the parameters of interest will be β_3 and β_4.

3.3 The optimal response on impact

Let us assume that the system is initially at rest with all disturbances equal to zero and that at time t=t* the real exchange rate experiences a positive shock of size $\sigma_{\varepsilon v}$. As mentioned before, this external shock can take the form of an increase in the foreign real interest rate and the central bank will set the implicit policy instrument by choosing how to combine a real depreciation and an increase in the local real interest rate. This optimal combination will be indirectly determined by the size and direction of the adjustment in the domestic nominal interest rate (the explicit policy instrument) which is given by equation (5) above. Thus, and according to this expression, the monetary authority will initially respond raising the nominal interest by a magnitude given by $\beta_3\sigma_{\varepsilon v}$, where:

$$\beta_3 = \frac{\delta^2\theta(\alpha+\lambda^2) + \delta(\sigma(\alpha+\lambda^2) + 2\lambda\gamma\theta) + \gamma\sigma\lambda + \gamma^2\theta}{\delta^2\theta^2(\alpha+\lambda^2) + 2\delta(\sigma\theta(\alpha+\lambda^2) + \lambda\gamma\theta^2) + \sigma^2(\alpha+\lambda^2) + 2\lambda\gamma\theta\sigma + \gamma^2\theta^2} \tag{6}$$

At this point, and in order to understand how this optimal combination works, it proves instructive to explore the relationship between ϕ_3 and ϕ_4 in expression (4). In particular, it can be shown that $\rho\phi_3 + \phi_4 = 0$, where ρ is the autorregresive parameter of the exchange rate disturbance term. An important implication of this is that if we only introduce a shock in v_t for t=t*, pass-through considerations will only be relevant on impact. This result is not surprising since we are only allowing for the unexpected component of the real exchange rate to affect inflation, and it implies that any movement in the current nominal interest rate can be directly translated into a movement in the real interest rate (i.e. $E_t(\pi_{t+1}) = 0$). With this in mind, and by exploring equation (3), it is easy to verify that in the extreme case where no exchange rate adjustment is allowed $\beta_3 = 1/\theta$. On the other hand, and if the real exchange rate is allowed to absorb all the shock, it is obvious that $\beta_3 = 0$.

By looking at (6), it is clear that the sign and magnitude of the response on impact is a convolution of all the underlying parameters of the model. For the purpose of this analysis, however, we will only concentrate on the role of δ and γ, i.e. on the effects of the real exchange rate on output and inflation, respectively.

3.3.1 Exchange rate effects on output

To begin addressing these effects, Figure 1 depicts the evolution of β_3 for different values of δ. Note that this first representation does not allow $\beta_3 \leq 0$. In fact, this possibility does not only depend on d but also on the values of the other parameter of interest: γ [6].

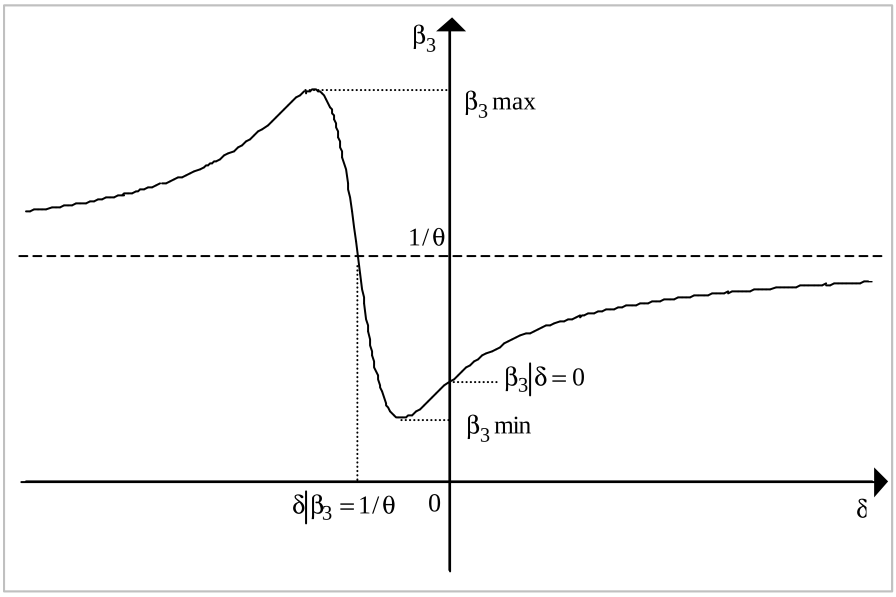
Let us start by considering the case where the real exchange rate has no direct effect on output (i.e. $\delta = 0$). Under this circumstances, the parameter governing the optimal response on impact will take the form:

$$\beta_3\big|_{\delta=0} = \frac{\gamma(\sigma\lambda + \gamma\theta)}{\sigma^2(\alpha + \lambda^2) + \gamma\theta(\gamma\theta + 2\sigma\lambda)} \qquad (7)$$

which corresponds to the intercept of the function described in Figure 1.

[6] In particular, the possibility of solving for real roots of d when the numerator of (6) is set equal to zero depends on the expression: $\sqrt{\sigma^2(\alpha^2 + 2\alpha\lambda + \lambda^4) - 4\alpha\theta^2\gamma^2}$. Thus, and taking all other parameters as given, particularly high values of ? would imply that there is no real value of d for which the optimal response involves allowing the real exchange rate to absorb all the shock (i.e. $\beta_3 = 0$). In Figure 1, the degree of pass-through has been set such that $\gamma^2 > \sigma^2(\alpha^2 + 2\alpha\lambda + \lambda^4)/4\alpha\theta^2$.

Figure 1



Clearly, and with $\delta = 0$, the monetary authority will choose to raise the interest rate in order to stabilize inflation. However, in this case the central bank faces the kind of trade-off that arises under the presence of cost push inflation (a positive shock in ų). In particular, the reduction of inflation implies a cost in terms of output contraction (via the direct effect of the interest rate on aggregate demand). The expression indicating this trade-off, however, is now quite more complex since the connection between inflation and the interest rate is not only given via the effects of the latter on output. To illustrate this point, consider the extreme case where no weight is given to output fluctuations ($\alpha = 0$) and inflation does not depend on the output gap ($\lambda = 0$). With this restrictions, (7) simplifies to $1/\theta$, which implies that no exchange rate adjustment will be allowed. Under these circumstances, the optimal response calls for a complete stabilization of the exchange rate since this implies that inflation (the only concern of the central bank) will be set equal to its target level. On the other hand, it is easy to verify that (7) is decreasing in α: if the central bank is more concerned about output fluctuations, it will allow a larger adjustment in the real exchange rate (recall that $\delta = 0$).

If now allow for expansionary real depreciations ($\delta > 0$), it is clear from Figure 1 that the optimal response will imply a tighter monetary stance[7]. As δ increases, the interest rate will absorb a larger proportion of the shock, however, there is no finite value of d for which the central bank will decide to completely stabilize the exchange rate. This "partial fear of floating" result resembles Parrado and Velasco's (2002) conclusion about how should a small open economy react to a foreign shock. In fact, they found that if an increase in the foreign interest rate has a net positive effect on output (via an exchange rate depreciation), this will call for the local interest rate to mimic, but only partially, the movement of its foreign counterpart[8].

Let us now consider the case of a contractionary real depreciation. As revealed by Figure 1, it is still possible to obtain "fear of floating"-type results after allowing δ to take negative values. In particular, and despite the fact that output is driven below capacity by the shock, the optimal response may call for an increase in the interest rate (a stance that might seem procyclical).

The more remarkable result, however, is that the monetary stance is a non-monotonic function of δ (i.e. of how contractionary is the depreciation). In fact, and if we regard "fear of floating"-type results as positively related to the degree of monetary tightness (or to the proportion of the external shock that is absorbed by the domestic interest rate), Figure 1 reveals that we can translate more contractionary depreciations into more "fear of floating"-type responses only for those values of δ for which the parameter governing

[7] In the rest of the analysis the monetary stance will be described in terms of the nominal interest rate (the explicit policy instrument).

[8] The example with which they illustrate this result accounts for a decrease in the foreign interest rate. However, it is not difficult to consider the opposite case in order to be consistent with the type of shock driving the present analysis.

the overall response lies between $\beta_3 \min$ and $\beta_3 \max$. For the purpose of this analysis, let us define that interval as the "fear of floating area" and concentrate on its implications[9]. The first result that is worth noting is that, within that area, there exists a finite value of d for which the optimal response calls for a complete stabilization of the exchange rate $(\delta|_{\beta_3=1/\theta})$. According to Figure 1, for values of d such that $\delta|_{\beta_3 \min} > \delta > \delta|_{\beta_3=1/\theta}$, the central bank will allow certain degree of real exchange rate adjustment, while if $\delta|_{\beta_3=1/\theta} > \delta > \delta|_{\beta_3 \max}$ the monetary authority will decide to more than offset the shock (i.e. it will induce a real appreciation).

At this point, and to start uncovering the intuition behind the above conditions, we can bring into the analysis the main results and definitions of the analytical framework developed by Hausmann, Panizza and Stein (2000). In particular, they define two channels through which the exchange rate operates on output: a "credit channel" (given by its effects on the interest rate) and a "balance sheet channel" (given by its direct effect on aggregate demand); the first being positive while the latter negative. With this definitions in mind, it is possible to relate the results obtained in the "fear of floating area" to their conclusions. Their model predicts that if the "credit channel" dominates the "balance sheet channel", the central bank will allow a partial depreciation of the exchange rate. On the other hand, if these effects compensate each other, the whole shock will be absorbed by the interest rate, while if the latter dominates the former, the central bank will respond with a restrictive monetary policy that will lead to an appreciation of the exchange rate. These three scenarios can be directly translated into the above conditions: $\delta|_{\beta_3 \min} > \delta > \delta|_{\beta_3=1/\theta}$, $\delta = \delta|_{\beta_3=1/\theta}$ and $\delta|_{\beta_3=1/\theta} > \delta > \delta|_{\beta_3 \max}$, respectively.

[9] If we recall that β_3 can also take negative values, it is clear that the optimal response may imply an interest rate reduction. The interval $(\beta_3 \min, \beta_3 \max)$, however, still accords with the above definition since within the "fear of floating area" a higher value of $|\delta|$ would always imply a tighter monetary stance even if we allow for a negative $\beta_3 \min$.

To formally see how these conditions parallel their conclusions, let us concentrate on the second possibility. Before looking at the underlying expressions, it is worth noting that since the exchange rate and the interest rate are linked through equation (3), the net impact of the exchange rate on output (determined by the size and direction of what they define as the "credit" and "balance sheet" channels) is given by $\frac{\partial y_t}{\partial r_t}\frac{\partial r_t}{\partial q_t}+\frac{\partial y_t}{\partial q_t}=\frac{\sigma}{\theta}+\delta$, where r_t is the real interest rate and $\delta<0$. The second scenario (according to their results), implies that these effects offset each other, which means that $\delta=-\frac{\sigma}{\theta}$, and the optimal response will be to allow for no exchange rate adjustment. Now, and in order to solve for $\delta|_{\beta_3=1/\theta}$ (no exchange rate adjustment) we need to impose the condition $\beta_3=1/\theta$ to obtain:

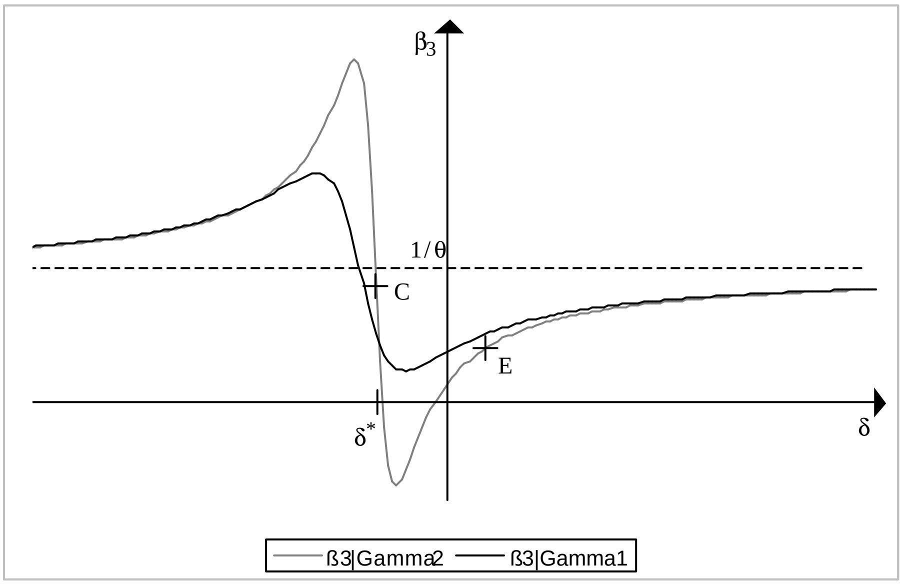
$$\delta|_{\beta_3=1/\theta}=-\frac{\lambda\gamma\theta+\sigma(\alpha+\lambda^2)}{\theta(\alpha+\lambda^2)} \tag{8}$$

In fact, this is the finite value of d for which the interest rate will absorb all the shock, and to compare this result with the condition derived when working with the "credit" and "balance sheet" channels, we need to impose one further restriction to accord with Hausmann, *et. al.* (2000) inflation equation: $\lambda=0$. After setting $\lambda=0$ it is easy to verify that the value $\delta|_{\beta_3=1/\theta}$ within the "fear of floating area" is exactly the same as that derived when imposing $\frac{\partial y_t}{\partial r_t}\frac{\partial r_t}{\partial q_t}+\frac{\partial y_t}{\partial q_t}=0$. Under this conditions, the central bank's objective is minimized by stabilizing inflation and allowing output to fluctuate as if no interest rate adjustment was introduced. In fact, and since the loss in terms of output per unit increase in q_t $(-\delta)$ is the same as what the central bank "saves" by not raising the interest rate (again per unit increase in q_t, i.e. σ/θ), it will choose to completely stabilize the exchange rate since this guarantees that inflation will be set equal to its target level (recall that for this example we have imposed $\lambda = 0$)[10].

3.3.2 Exchange rate effects on inflation

Additional exploration of the "fear of floating area" requires to begin addressing the role of the pass-through coefficient. For this, Figure 2 depicts the evolution of β_3 with respect to δ for two different values of γ, where $\gamma_1 > \gamma_2$ (the former being the same as the one used in Figure 1 and the latter set such that negative values of β_3 exist).

Figure 2



For values of δ such that $\delta \geq 0$, the role of the pass-through coefficient is clear. For a given δ, a larger value of γ will lead to a tighter monetary stance (i.e. the real exchange rate will be allowed to absorb a smaller proportion of the shock).

10 With this intuition in mind, it should be clear that, since we are introducing a shock in v_t, the expansionary or contractionary effects of the real exchange rate have been defined in absolute terms. In this sense, depreciations have been regarded as contractionary as soon as $\delta < 0$ and not just when $\delta < -\sigma/\theta$.

If we now allow for contractionary depreciations and return to the “fear of floating area”, γ has a much more interesting role. In fact, increasing the pass-through coefficient will have very different implications depending on the underlying value of δ: after allowing for larger pass-through effects, the optimal response may call for an increase or decrease in monetary tightness depending on whether $\delta > \delta^*$ or $\delta < \delta^*$, respectively.

At this point it is also important to realise that ? plays a vital role for the existence of the “fear of floating area”. In fact, it can be shown that the difference between $\delta|_{\beta_3=\beta_{3\,\min}}$ and $\delta|_{\beta_3=\beta_{3\,\max}}$ is given by: $\dfrac{2\gamma\sqrt{\alpha}}{(\alpha+\lambda^2)}$. Thus, setting $\gamma = 0$ will imply that there are no negative values of d for which an increase in $|\delta|$ can be directly translated into an increase in the degree monetary tightness (i.e. the function will not exhibit a negative slope)[11].

3.3.3 Addressing the empirical evidence

In order to relate these results with the conclusions that stem from the empirical evidence, we can rely on the work of Hausmann, *et. al.* (2000). In particular, they used a sample of 30 countries (officially classified as having a floating regime or wide bands) to explain the volatility of the exchange rate relative to that of interest rates and international reserves in terms of a pass-through estimate and a variable accounting for the ability of countries to borrow internationally in their own currency. Clearly, a low value for their dependant variables would imply stronger evidence in favour of a “fear of floating” behaviour meaning that, if we rely on our basic intuition, the expected sign associated to the pass-through coefficient should be negative while the impact of countries’ ability to borrow internationally in their own currency should be positive. However, only their proxy for currency mismatches proved statistically significant and with the expected sign in all of their regressions.

[11] Moreover, setting $\gamma = 0$ has serious implications for the structure of β_3. These will be explored when accounting for the full dynamics of the model.

In order to adequately relate these findings to the analytical framework just developed, it is worth noting that their most robust regressor was a dummy variable that adopted the value of 1 if the country's ratio of foreign securities issued in its own currency relative to its total stock of securities exceeded a threshold value of 0.1. As expected, the sign associated to this explanatory variable was positive: access to foreign funds issued in the local currency will imply less currency mismatches and, thus, a higher volatility of the exchange rate relative to the domestic interest rate (i.e. less "fear of floating").

In accordance with the intuition behind the dummy variable, we can assume that in those countries for which it was set equal to one, real depreciations have a conventional expansionary effect and vice-versa. Having defined two broad groups, let us now assume (for simplicity) that they are both subject to an external shock of similar magnitude and address their central bank's response. For this, and in order to account for the significance and positive sign related to the dummy, consider the two points labelled C and E in Figure 2. The relative position of these points stems from the fact that in those countries where real depreciations are contractionary (dummy = 0), the monetary authority will react in a manner that reduces the ratio (exchange rate volatility / interest rate volatility) when compared to that of economies where the dummy = 1[12]. Finally, consider the consequences of increasing the degree of pass-through. Clearly, the effects on the monetary stance (and hence on the "fear of floating" indicator) have the opposite sign.

Obviously, the idea behind this exercise was not to predict the exact magnitude of the responses but to stress an issue implied by the results of the previous section: it appears to be particularly important to address the effects of the exchange rate on output and inflation in a simultaneous manner when considering the possibility of a contractionary

[12] Note that it is possible to consider shocks of different magnitude and still have results where the ratio (exchange rate volatility/interest rate volatility) is unambiguously lower for economy C. By looking at (3) it can be shown that the latter will be true as long as $1-\theta\beta_3^E > (\sigma_{\varepsilon v}^C / \sigma_{\varepsilon v}^E)(1-\theta\beta_3^C)$, where $\sigma_{\varepsilon v}^C > \sigma_{\varepsilon v}^E$ (i.e. an economy like C is subject to a larger shock).

real depreciation. In fact, results as the one described above can help to understand why, and contrary to what one could expect by looking at the preferences of a typical central bank, pass-through seems not to be an issue when considered in isolation. In this sense, the results of the analytical framework presented here predict that we would probably find that the degree of pass-through is significant if we, for example, control for the possibility that the parameter governing its effect has a different sign depending on how output responds to real exchange rate movements[13].

3.4 The optimal response: full dynamics

After looking at (6) it is clear that β_3 does not depend on the autorregresive parameter ρ. An important implication of this is that we could have safely assumed that v_t follows itself an i.i.d. process with zero mean and constant variance, and all the results of the previous section would have remained unchanged. This is due to the fact that we have only allowed inflation to depend on the unexpected component of the real exchange rate. This assumption has helped to derive tractable analytical solutions as the ones presented above, but will imply the need to abstract from some of the previous results if we are to allow for richer dynamics. In particular, this assumption means that pass-through considerations are only relevant on impact, so if we solve for the parameter governing the response for periods ahead of t* $(n \geq 1)$ we would obtain:

$$\begin{aligned} i_{t^*+n} &= \beta_3 \rho^n \sigma_{\varepsilon v} + \beta_4 \rho^{(n-1)} \sigma_{\varepsilon v} \\ &= \sigma_{\varepsilon v} \rho^n (\beta_3 + \beta_4 \rho^{-1}) \\ &= \sigma_{\varepsilon v} \rho^n \left[\frac{\delta}{\sigma + \delta\theta} \right] \end{aligned} \tag{9}$$

since $\beta_4 = \dfrac{-\rho\gamma\sigma(\lambda\theta\delta + \lambda\sigma + \gamma\theta)}{(\sigma+\delta\theta)(\delta^2\theta^2(\alpha+\lambda^2) + 2\delta(\sigma\theta(\alpha+\lambda^2) + \lambda\gamma\theta^2) + \sigma^2(\alpha+\lambda^2) + 2\lambda\gamma\theta\sigma + \gamma^2\theta^2)}$.

---

[13] This could be done, for example, adding the regressor given by the multiplication of the dummy already described by the pass-through estimate. A refined version would call for the inclusion of asymmetric effects of the kind stressed in STAR models, where the state or switching variable could be an adequate estimate of δ.

According to the above intuition, the expression in brackets in (9) corresponds to that obtained for β_3 if we set $\gamma = 0$. This implies that for t>t* the central bank will react as if the exchange rate had no effect on inflation, meaning that the remaining proportion of $\sigma_{\varepsilon v}$ would resemble a demand shock. In fact, this will call for an interest rate adjustment such that $y_t = 0$, since in this way the central bank will be able to hit its inflation and output targets simultaneously. Not surprisingly, this will be achieved by increasing the interest rate by the amount given in (9) since with this:

$$
\begin{aligned}
y_{t^*+n} &= -\sigma\left[i_{t^*+n}\right] + \delta\left[-\theta i_{t^*+n} + \rho^n \sigma_{\varepsilon v}\right] \\
&= -(\sigma + \delta\theta) i_{t^*+n} + \delta\rho^n \sigma_{\varepsilon v} \\
&= -(\sigma + \delta\theta)\sigma_{\varepsilon v}\rho^n \left[\frac{\delta}{\sigma + \delta\theta}\right] + \delta\rho^n \sigma_{\varepsilon v} \\
&= 0
\end{aligned}
\tag{10}
$$

By exploring (9) it is clear that we can no longer consider values of d in a continuous manner. In fact, the function relating the optimal response to this parameter will present a discontinuity given when $\delta = -\sigma/\theta$, so we would need to abstract from those points in its vicinity.

If we recall the intuition gained when analysing the reaction on impact, we can see why in this case the response is not uniquely determined if $\delta = -\sigma/\theta$. Under this circumstances, the central bank has no possibility of stabilizing output, but if $\gamma \neq 0$ it can still minimize its objective. If we further assume (for simplicity) that $\lambda = 0$, the latter will be achieved by completely stabilizing the exchange rate[14]. Under the present circumstances ($\gamma = 0$), however, the only way to stabilize inflation is if output is also stabilized, something that can not be done when $\delta = -\sigma/\theta$[15].

In order to account for this discontinuity, Figure 3 proposes a comparison similar to the one in the previous section but considering a larger value for $|\delta|$ when accounting for

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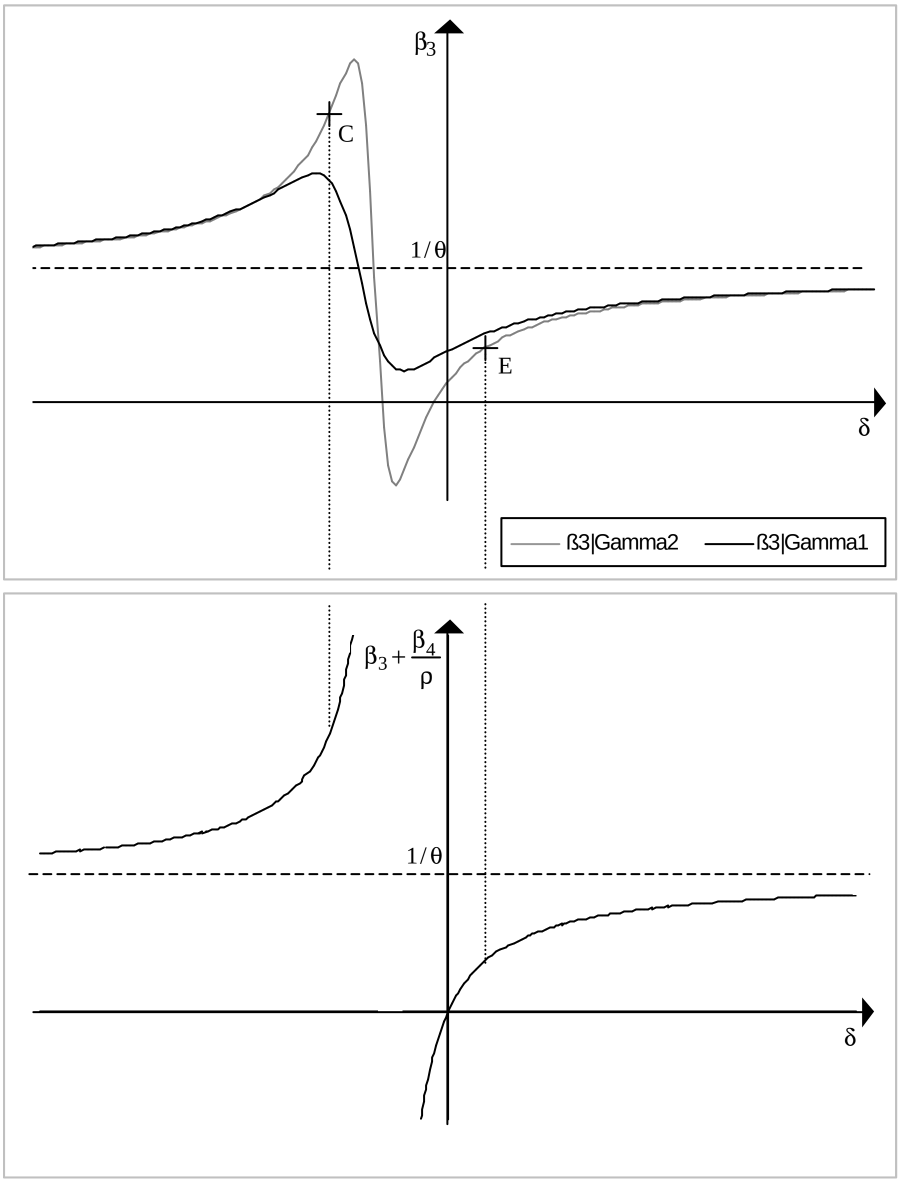
14 Recall the discussion relating expression (8) to the "credit" and "balance sheet" channels.

15 If $\delta = -\sigma/\theta$ output will always fluctuate as if no interest rate adjustment is introduced, no matter the central bank's response.

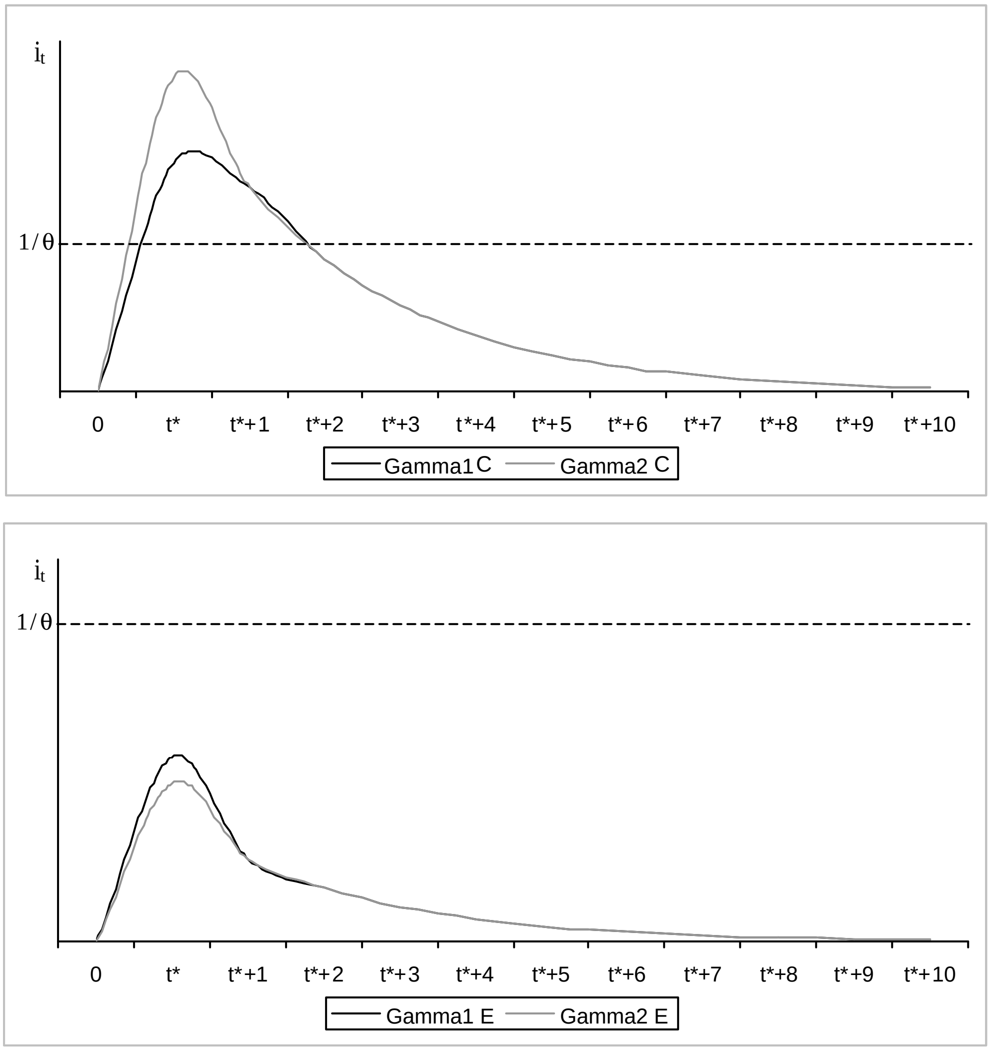
contractionary depreciations. The first panel just replicates the functions represented in Figure 2 and corresponds to the reaction on impact; the lower panel accounts for the value of the function in brackets in equation (9). The related dynamics for the points labelled C and E are finally given in Figure 4[16].

Figure 3



[16] For this representation, ρ was arbitrarily chosen so that that $\rho^{10} \cong 0$. The selection of this parameter does not have any major implication for the type of comparisons that are proposed in this analysis.

Figure 4



As revealed in this representation, raising the pass-through coefficient (recall that $\gamma_1 > \gamma_2$) may still have different effects on the overall monetary stance. In terms of interest rate variability, it is clear that an increase in γ will reduce this indicator for an economy characterized by point C while the opposite will happen for that situated in a point like E. However, the implications for exchange rate variability itself are now not so clear since economy C was already choosing to more than offset the shock[17].

[17] Note that for the example presented in Figure 2, the ratio (exchange rate volatility)/(interest rate volatility) for economy C unambiguously increases after raising the pass-through parameter.

Finally, it is worth noting that after allowing for negative values of δ, if we want to exploit the full dynamics of the model and obtain systematic "fear of floating" results (where the central bank decides to raise the interest rate every period as shown in the upper panel of Figure 4) it is necessary to consider highly contractionary depreciations. In fact, and if we consider values of δ such that $\delta|_{\beta_3 \min} < \delta < 0$, the interest rate may only exhibit a significant rise on impact, while for t>t* the monetary stance could be regarded as expansionary[18].

4. Conclusions

Based on a simple open economy framework, and by assuming what central banks usually do (act discretionally to minimize output and inflation fluctuations), it has been possible to generate "fear of floating"-type responses and uncover some important implications about to role of pass-through effects and contractionary depreciations when explaining this behaviour.

The results suggest that real exchange rate effects on output and inflation (determined by parameters δ and γ, respectively) both work in the same direction when we assign a traditional expansionary effect to real depreciations: increasing δ and/or γ will call for a tighter monetary stance.

The type of trade-offs that arise when allowing for contractionary depreciations, however, turn this evaluation quite more complicated, since the direction of the effects related to one these parameters cannot be addressed without considering the other. This analysis reveals that we will not necessarily observe "fear of floating"-type results when $\delta < 0$ and that increasing the negative effect of the real exchange rate on output will not necessarily lead to a tighter monetary stance. In fact, there exists a well defined parameter interval for

18 This particular result resembles Céspedes, *et. al.* (2000) conclusions about the optimal monetary response under flexible inflation targeting in the event of an increase in the world interest rate. Their results reveal that the policy instrument only raises significantly in the first period.

which the latter is true and its existence, in turn, depends crucially on the pass-through coefficient. Finally, the effects of this coefficient are also related to the underlying value of δ, in the sense that an increase in ? may well imply the need to tighten or relax the monetary stance. These results, which prove particularly robust when working with the optimal response on impact (or equivalently when we allow for no persistence in exchange rate shocks), may help to understand some of the empirical findings, in particular, why have pass-through effects failed to appear significant when accounting for low exchange rate and high interest rate variability.

If we consider the model's full dynamics, it is still possible to have similar results but with somewhat weaker implications. In particular, a systematic increase in the interest rate is only observable if we allow for highly contractionary depreciations. In this sense, an improvement may call for a different specification of the Phillips curve that will allow pass-through effects to be relevant in periods after impact. In this way, it will be possible to account for richer dynamics. However, and in order to avoid unruly analytical solutions, this would imply a search for suitable parameter values, an effort that could require, in turn, to uncover the relationship between some of the broad parameters discussed here and those that emerge from somewhat deeper foundations.

In doing so, however, we will need to consider that, in the same manner as economies are subject to shocks of different magnitude, they can exhibit quite different underlying structures. In fact, the possibility of having "fear of floating"-type results is directly related to how the optimal combination between interest rate shifts and real depreciations is set, and this depends crucially on policy maker's preferences and on how their target variables respond to innovations. By allowing changes in only two of these responses, this exploration has revealed that accounting for such differences can have crucial implications when explaining the facts, implications that may eventually help to make the "fear of floating puzzle" less puzzling.

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