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Two Targets, Two Instruments: Monetary and Exchange Rate Policies in Emerging Market Economies

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Executive Summary

This note examines the case for using two policy instruments—the policy interest rate and sterilized foreign exchange market intervention—in emerging market countries aiming to maintain low inflation while avoiding currency movements that clearly represent substantial deviations of the exchange rate from its medium-run multilaterally-consistent value. It is often said that paying attention to the exchange rate can undermine the credibility of a commitment to low inflation. In fact, this argument has been used to suggest that countries unwilling to allow a free floating exchange rate should not adopt inflation targeting (IT) as part of their policy framework. And as others have noted, a number of early adopters of IT made an explicit commitment to allow the exchange rate to float more freely.

But in countries with significant currency mismatches in domestic balance sheets, high pass-through of the exchange rate to inflation, and limited inter-sectoral factor mobility, ignoring exchange rate volatility can itself prove costly. And with emerging-market countries' more limited integration with global financial markets and smaller stocks of outstanding local-currency assets, scope for using sterilized intervention may be greater.

The framework we use to explore these questions is unabashedly ad hoc. It makes two assumptions: that large deviations of the real exchange rate from its multilaterally-warranted value are costly (e.g., dynamic Dutch disease, balance sheet effects), implying that central banks should indeed care about the exchange rate in addition to inflation; and second, that there is imperfect capital mobility/asset substitutability, and so central banks can avail themselves of both policy interest rates and foreign exchange market intervention. How should a central bank use these two policy instruments to achieve its two targets?

Fully discretionary monetary and exchange rate policies obviously allow maximum flexibility in responding to unexpected shocks. Yet full discretion is not costless: it may result in conflicting signals about the central bank's objectives, thus undermining credibility. For this reason, our analysis highlights the benefits for the monetary authority of signaling that the policy interest rate will be used to safeguard the primacy of the inflation target. But if, for example, a sudden surge in capital inflows leads to a large, temporary appreciation of the currency above its medium-term value, and that results in economic dislocation, then some intervention in the foreign exchange (FX) market is likely to be optimal even under an IT regime. The analysis underscores that such intervention should only be undertaken against shocks that move the exchange rate away from its medium-run multilaterally-consistent value, and that it should be two-way, involving both purchases and sales of FX reserves. Because the central bank would be deploying its second instrument to influence the exchange rate, while adjusting the policy interest rate to meet its inflation goal, the two-target/two-instrument regime should not give confusing signals to the public. Moreover, to the extent that inflows are driven by self-fulfilling expectations of currency appreciation, intervention could help to reduce incentives for carry trade and other short-term capital flows.

This note also briefly considers some multilateral aspects of monetary policy, in particular the interaction of policies across emerging-market economies, and how unilateral actions compare to cooperative solutions. Our tentative conclusion is that an IT regime combined with FX intervention instruments likely dominates from a global welfare perspective either unilateral discretion or a narrow IT regime in which the intervention instrument is foresworn.

I. INTRODUCTION

It is often claimed that inflation targeting (IT), to be successful, needs to include a high degree of exchange rate flexibility, with the policy rate geared to stabilizing inflation and the exchange rate allowed to fluctuate freely. The early adopters of IT were very much of this view. Their logic was simply that, as long as inflation targets coexist with other objectives of monetary policy, tension between the different policy goals would be unavoidable. Allowing free floating was considered by many to be a litmus test of a country's commitment to a credible IT regime for low and stable inflation (Masson et al., 1997).

There are reasons to question the logic of this position. The crisis has taught us that policy-makers need to deliver more than stable consumer prices if they are to achieve sustained and stable growth, and that the instruments at their disposal include more than just the policy interest rate. In the context of the emerging markets, it has long been recognized—and to a degree reinforced by the crisis—that significant balance-sheet mismatches imply that it is rarely optimal to ignore possibly large deviations of the exchange rate from its medium-run equilibrium, even in an IT context. On the contrary, reacting to such changes can deliver better economic outcomes under IT than benign neglect of the exchange rate (Stone et al., 2009). Thus, there are potentially two policy targets: inflation and the exchange rate.

While emerging market countries are certainly much more integrated in global financial markets than a couple decades ago, their proneness to experience sudden stops suggests that this integration is far from perfect. Given also their smaller stocks of outstanding local-currency denominated assets than most advanced economies, emerging market economies have greater scope for sterilized intervention. This opens up the fortuitous possibility that policymakers may be operating in a two-target, two-instrument world.

In this note, we re-examine the case for using two policy instruments (the policy interest rate and FX market intervention) under an IT regime in a stylized emerging market economy with distinct structural features. The two central assumptions are that: first, large movements in the real exchange rate away from medium-run equilibrium are costly (e.g., balance-sheet effects, dynamic Dutch disease), so central banks should care about such deviations as well as inflation; and second, there is imperfect capital mobility/asset substitutability, so central banks indeed have two instruments (the policy interest rate and FX intervention). Although part of the broader policy toolkit—for instance, in the face of capital inflows—macro-prudential policies and capital controls are not discussed here (see Ostry et al., 2010, 2011), though intervention might diminish the case for using temporary controls on capital inflows.

This note explores the contours of monetary/exchange rate policy in this two-target/two-instrument world. The crux of our argument is laid out in the next section using the simplest possible analytical framework to make our point. We then briefly describe how EME central banks actually behave in the face of various shocks; specifically, how they adjust the policy rate and undertake FX intervention in response to movements in the real exchange rate. Next we survey evidence on the effectiveness of sterilized intervention in EMEs, since our argument is predicated on the central bank having two independent instruments. While the evidence is mixed, it is at least suggestive of the central bank's scope for influencing the path of the exchange rate. We then turn to a stylized model to examine how the central bank

would wish to deploy its two instruments in response to shocks under IT with or without sterilized FX intervention (the Online Appendix considers discretionary monetary policies with or without intervention). Key results from the model are that intervention should only be used in the face of shocks that push the currency away from its medium-run warranted value; and that it should be two-way (i.e., involving, at different times, purchases or sales of official reserves, with no net accumulation or loss). In a penultimate section, we expand the discussion to consider some multilateral issues, arguing that an IT regime with use of the FX instrument would bring the global configuration of exchange rates closer to their multilaterally-warranted ranges than would unconstrained discretion or a narrow IT regime, and this without the need for costly explicit policy coordination mechanisms. A final section draws out the main policy implications.

II. TWO TARGETS, TWO INSTRUMENTS

The global financial crisis has reminded emerging markets, if they needed reminding, that capital flows can be highly volatile and that crises need not be home grown. So how should EME central banks react to various shocks? Leaving aside the (few) cases of formal pegs, the options for EME central banks are (to caricature a bit) either fully discretionary monetary and exchange rate policy or, at the other extreme, strict IT with freely-floating currencies and the policy interest rate responding only to changes in expected inflation. Given that many EME central banks have established their price-stability credentials only recently (and often after histories of high inflation), IT frameworks are generally thought to be useful for guiding policy and maintaining credibility. Although such frameworks typically go hand-in-hand with free floating in advanced economies, there is no logically necessary reason for them to do so in EMEs. If EME central banks worry about currency movements away from medium-run levels (which, we argue, they typically do), then an IT-cum-sterilized-FX-intervention regime may provide the best of both worlds: the discipline of IT with the exchange rate responsiveness of a managed float. While EME central banks have implicitly recognized this long ago, our purpose here is to clarify and formalize the rationale of their practice.

To fix ideas, it is useful to contrast the response of the central bank to aggregate demand and capital inflow shocks under alternative policy regimes. If the economy exhibits "divine coincidence" (in the sense that the inflation target is consistent with a zero output gap), then IT would imply that the policy interest rate should be lowered in the face of capital inflows or negative shocks to aggregate demand. Under the floating exchange rate regime, the central bank does not intervene in the FX markets, allowing the exchange rate to appreciate when there are capital inflows and depreciate when there are negative demand shocks.

But suppose policymakers are not indifferent to movements of the exchange rate. As elaborated below, policymakers may worry about sharp depreciations because of the foreign currency exposure of unhedged domestic borrowers, or they may worry about appreciation pressures that reduce competitiveness, especially if the currency movement is a mean-reverting deviation from its medium-run level, and leaves unemployment and economic dislocation in its wake. Even if policymakers do not target a particular exchange rate level, including because the precise equilibrium value may be difficult to determine, they may wish to limit large and abrupt movements in either direction. In other words, there may be a "comfort zone" beyond which the authorities would not want to see the exchange rate move.

If policymakers do care about the exchange rate, can they do better than the strict IT-cum-floating-exchange-rate regime implies? The answer is yes. Indeed, in this very simple example, there is a clear policy assignment rule: the interest rate should be used to meet the inflation target, while sterilized intervention should be geared to the exchange rate objective (see de Gregorio, 2008, for a discussion of the Chilean case). Thus, the policy interest rate would be lowered in the face of negative demand shocks but would not react to capital flow shocks, while intervention would be used to resist appreciation pressures from inflows and depreciation from negative demand shocks.

Despite its simplicity, this benchmark model embodies a basic truth: if policymakers have multiple objectives (which they surely do), and if the central bank has multiple instruments (which it probably has), then in general it makes sense to use the full set of available instruments. While it is difficult to argue against this point in the abstract, in our particular context, three objections can be raised. First, that modern EME central banks (like their advanced-economy counterparts) are largely indifferent to the level of the exchange rate provided they are meeting their inflation objective. Second, that central banks do not really have two instruments because sterilized intervention is ineffective. Third, that the flexibility afforded by an active exchange rate policy is not costless because it potentially sends confusing signals about the primacy of the inflation target, undermining its credibility.

In the following sections, we take up the first two objections—that central banks are largely indifferent to the level of the exchange rate, and that they may have only one effective policy instrument. On whether having a second policy objective undermines the credibility of the inflation target, we would argue *no*—provided the central bank indeed has two instruments. In such a case, explicit recognition of the central bank's preferences over the exchange rate might actually strengthen the credibility of the central bank's inflation target. This is because policy is not made in a vacuum. When the exchange rate moves strongly out of line with fundamentals, the central bank inevitably comes under pressure to do something about it. Obstinately refusing to acknowledge the problem and the need for policy adjustments likely undermines policy credibility because the public realizes that the stance is untenable. By acknowledging that the exchange rate has moved too far or too abruptly, and by openly undertaking foreign exchange intervention, an inflation-targeting central bank's claim that it will respect its inflation target arguably becomes more—not less—credible. At the same time, it is worth acknowledging that aiming for an exchange rate that deviates substantially from that consistent with medium-term fundamentals (itself never easy to estimate) may have consequences for inflation that ultimately undermine the central bank's inflation target. This underscores the importance of limiting any intervention to instances where the exchange rate is clearly deviating from its medium-term warranted value.

Accepting the logic of this argument still leaves a number of complications that need to be taken into account. For example, sterilized intervention is not costless, so the central bank will not want to intervene in arbitrarily large amounts—especially if the intervention is not very effective or the inflows are highly persistent. Moreover, there are tradeoffs between rules (inflation targeting) and discretion when policy credibility is fragile. In section V, we enrich the discussion to take account of such factors, and show that, while they slightly

modify our conclusions above (for instance, the simple policy assignment rule no longer holds), they do not fundamentally overturn them. But first we establish that EME central banks typically do care about the exchange rate, and that sterilized intervention is a plausible instrument in the context of most emerging market currencies.

III. POLICIES OF EME CENTRAL BANKS

What do EME central banks do in practice? Almost inevitably, the exchange rate plays a more important role in emerging market economies than advanced economies, where most domestic and foreign transactions are in local currency, markets are deeper, and the private sector is better equipped to absorb exchange rate changes. Pass-through from the exchange rate to inflation is typically higher in EMEs, often reflecting more open economies, the currency denomination of trade, and, at times, less credible monetary policies. Beyond the effects on inflation, given currency mismatches on domestic balance sheets (public, financial, corporate, and households), many EME country authorities worry about sharp depreciations that could result in widespread bankruptcies, fire sales, and economic dislocation. Finally, given less developed domestic financial markets and the greater likelihood of credit constraints, firms in EMEs are less able to absorb mean-reverting appreciations of the exchange rate, so the loss of competitiveness associated with a surge of capital inflows is likely to have longer lived effects. Therefore, even if they do not set a particular target for the exchange rate, most EME central banks have an implicit "comfort zone" beyond which they would not want to see the exchange rate move (at least not abruptly), and this is reflected in their conduct of monetary and intervention policies (see also the related discussion of the "trilemma" index in Aizenman et al., 2008). That is not to suggest that EMEs should not try to enhance the economy's resilience to exchange rate movements—for instance, by developing and deepening markets—but such structural policies take time to implement, and in the meantime, the central bank may need to be mindful of sharp currency movements.

Interest Rate Rules

A number of studies have found that emerging market inflation targeters often (implicitly) include the exchange rate in their interest rate reaction function (Taylor rule); see, e.g., Mohanty and Klau (2005) and Aizenman et al. (2011). In a textbook IT setting, the exchange rate should only affect an inflation-targeting central bank's interest rate to the extent that it has an impact on expected inflation. But a more pragmatic approach should recognize the importance of the exchange rate in emerging market settings (for the reasons explained above), and provide some room for maneuvering within the inflation target framework. Garcia et al. (2011) present a model of hybrid inflation-targeting regimes. Their simulations support the view that financially robust advanced economies have relatively little to gain by including the exchange rate directly in the policy reaction function, but financially vulnerable EMEs might benefit by doing so in a limited way. These papers do not, however, envisage a systematic role for sterilized intervention in IT regimes (see, however, Benes et al., 2012, which models sterilized interventions as an additional instrument alongside the Taylor rule and affecting the economy through portfolio balance sheet effects in the financial sector). To see what EME central banks do in practice, Table 1 reports reduced-form Taylor rules for

a sample of EME IT central banks.[2] The explanatory variables include: the lagged dependent variable, since policy rates are adjusted slowly; the difference between expected inflation over the next four quarters (from Consensus Forecast) and the inflation target; and the lagged output gap (obtained from a rolling HP filter). The Taylor rule is augmented to include the deviation of the log of the real effective exchange rate from the level implied by a rolling HP filter. Since the regression controls for expected inflation, any effect of the REER on the policy rate will be over and above what could be justified by its pass-through to inflation.

Table 1, Column 1, only includes the inflation expectation deviation from its target level as an explanatory variable. Not surprisingly, inflation targeters respond to an increase in inflation expectations by raising the real interest rate; adding the lagged dependent variable (since policy interest rates are typically adjusted sluggishly) still yields a positive coefficient on the expected inflation deviation from target (Table 1, Column 2). The point estimate on the global financial crisis dummy is -0.8 percent (this point estimate would be smaller if other controls could capture the collapse in demand), suggesting extraordinary monetary loosening during the crisis. Table 1, Column 3, adds the lagged output gap and the change in the real exchange rate. The point estimate on the output gap suggest that real rates increase by 0.06 percentage points when output is 1 percentage point above potential (so a 1.5 percent gap that persists for four quarters would raise the policy rate by 0.25 percentage points).

Turning to the variable of interest, the deviation of the real exchange rate from its medium-run value, the point estimate suggests that a 10 percent appreciation of the currency lowers the policy interest rate by 0.29 percentage points.[3] This is substantial, especially as it represents the reaction of the policy rate to the exchange rate over and above any impact of the exchange rate's movement on expected inflation, and considering that the estimated coefficient is almost surely smaller than the true response because of simultaneity bias.[4]

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[2] The estimated Taylor rule is given by:

$$i_t - \pi^*_{t+4} = \beta_0 + \beta_1(i_{t-1} - \pi^*_{t-1}) + \beta_2(\pi^e_{t+4} - \pi^*_{t+4}) - \beta_3(\log(REER_t) - \log(\overline{REER_t})) +$$

$$\beta_4 YGAP_{t-1} - \beta\, D_{08:4-09:2} + \varepsilon_t$$

, where the dependent variable is the "target real interest rate" (the policy interest rate, i_t minus the four-quarter ahead inflation target π^*_{t+4}) and where REER is the log of the real effective exchange rate (an increase is an appreciation of the domestic currency), $\overline{REER}$ is the level implied by a rolling HP filter, YGAP is the output gap, D08:4-09:2 is a dummy variable intended to capture the exceptional behavior during the global financial crisis (which had the unusual combination of loosening of the policy rate despite sharp depreciations). The sample of EME IT countries includes: Brazil, Chile, Colombia, Czech Republic, Hungary, Indonesia, Korea, Mexico, Peru, Poland, Romania, Slovak Republic, Thailand and Turkey. Quarterly data by country cover the period from IT adoption until 2010, subject to availability.

[3] Previous studies had found that policy interest rates of emerging market ITers respond to the exchange rate (e.g., Mohanty and Klau, 2005, and Aizenman et al., 2011). But by controlling for expected inflation, our estimates can rule out the possibility that this is driven by pass-through of the exchange rate to inflation.

[4] In addition to the interest rate reacting to the real exchange rate (as central banks reduce policy rates in response to appreciation), the exchange rate is likely to respond to the interest rate. But the latter relationship goes in the opposite direction: a higher interest rate will appreciate the real exchange rate, yielding a positive regression coefficient. The finding of a negative regression coefficient is therefore despite this simultaneity bias, and the true response of the policy interest rate to the exchange rate is larger (more negative) than estimated.

When we estimate the regression country-by-country, the coefficient estimates are similar to those presented in Table 1, though the fewer observations mean that some of the coefficients (especially on REER) are statistically insignificant.

Our main conclusions from these estimates are that inflation-targeting central banks in EMEs generally conduct their interest rate policy in accordance with the "Taylor principle," tightening real interest rates when inflation is expected to be above its target or output is above its natural level, and—more interesting for our purposes—they respond to real exchange rate movements above and beyond any impact on expected inflation.

Table 1. Taylor Rules in Emerging Market Inflation Targeters: Panel Regression [1]/

	Dependent Variable: policy rate - inf. Target					
	(1)		(2)		(3)	
Lagged (policy rate - inflation target)			0.744	***	0.727	***
			[0.039]		[0.046]	
Expected inflation - inflation target	1.353	***	0.649	***	0.699	***
	[0.168]		[0.097]		[0.094]	
REER deviation from trend					-0.029	***
					[0.009]	
Lagged output gap					0.064	*
					[0.030]	
Dummy for global financial crisis	-0.271		-0.801	***	-0.840	***
	[0.438]		[0.251]		[0.286]	
Constant	2.233	***	0.383	***	0.462	***
	[0.081]		[0.097]		[0.113]	
Observations	522		516		470	
R-squared	0.334		0.821		0.812	
Number of Countries	14		14		14	

[1]/ Standard errors in brackets. *, ** and *** denote statistical significance at the 10, 5 and 1 percent level, respectively. REER is defined such that an increase denotes an appreciation of the currency.

Foreign Exchange Intervention

Turning to foreign exchange market intervention, a simple albeit imperfect statistic of the degree of intervention is the standard deviation of the change in reserves relative to the sum of the standard deviations of the change in reserves and of the change in the real exchange rate; this statistic ranges from zero (a pure float, no intervention) to unity (all shocks to the REER are perfectly smoothed).[5] For emerging market inflation targeters, the statistic is 0.63, which is not only positive but in fact not even appreciably lower than for EME central banks that do not have explicit inflation-targeting frameworks (whose intervention statistic is 0.73).

[5] The sample of non-inflation-targeting EMEs used here is Argentina, Costa Rica, Croatia, Dominican Republic, India, Kazakhstan, Malaysia, Russia, Sri Lanka, and Uruguay. Specifically, we calculate

$$\zeta = \sigma_{\Delta Reserves} / (\sigma_{\Delta Reserves} + \sigma_{\Delta REER})$$

Table 2 reports the result of a regression of change in international reserves on the log deviation of the REER from the level implied by a rolling HP filter. The first column reports the results for our sample of inflation targeters. The point estimate suggests a 10 percent appreciation of the currency would be associated with a 3.8 percent increase in reserves (again, this is probably an underestimate because simultaneity will tend to bias our estimates toward zero).[6] Table 3 (column 2) also reports analogous results for a comparator sample of *non*-IT countries since 2000, which have an even stronger response: 14.1 percent.[7]
The bottom line seems to be that inflation-targeting central banks in EMEs do intervene actively in the foreign exchange market (although rather less aggressively than their non-IT counterparts), and certainly do not follow freely floating exchange rate regimes.

Table 2. Change in Reserves as a Function of the Change in the REER [1]/

	Change in Reserves			
	IT		Non-IT	
	OLS		OLS	
REER deviation from trend	0.380	**	1.405	***
	[0.156]		[0.321]	
Dummy for global financial crisis	-8.795	*	-23.495	***
	[4.410]		[4.681]	
Constant	10.769	***	15.349	***
	[0.388]		[0.446]	
Observations	452		399	
R-squared	0.087		0.327	
Number of countries	14		10	

[1]/ Standard errors in brackets. *, ** and *** denote statistical significance at the 10, 5 and 1 percent level, respectively. An increase in the REER denotes an appreciation of the currency.

IV. Effectiveness of Foreign Exchange Intervention in EMEs

The argument that even inflation-targeting EME central banks might intervene to bring currency values closer to medium-run equilibrium is premised on FX intervention being an effective policy tool. There is little question that unsterilized intervention is effective in moving the exchange rate. But if it is only unsterilized intervention that works, then the

[6] In addition to the central bank purchasing foreign exchange reserves in the face of currency appreciation, the exchange rate will react to intervention. But this relationship goes in the opposite direction: central bank purchases of foreign exchange will tend to depreciate the exchange rate, yielding a negative coefficient. The finding of a positive regression coefficient is therefore despite this simultaneity bias, and the true response of foreign exchange intervention to an exchange rate appreciation is larger (more positive) than estimated.

[7] As in the case of the Taylor rule, results are very similar if we use the year-on-year change in the REER instead of this measure of deviation from trend. The point estimate for the IT sample declines from 0.38 to 0.35, while that for the non-IT sample declines from 1.41 to 1.07.

central bank would not have two policy instruments and our argument breaks down. What then is the evidence that sterilized intervention (i.e., purchases and sales of foreign exchange that leave the central bank's interest rate unchanged) has an effect on the exchange rate?

There are two main ways through which sterilized intervention can affect the exchange rate: the portfolio balance and the signaling channels. The former stems from the change in the relative supply of domestic and foreign currency assets following the intervention. If both types of assets are perfect substitutes (i.e., if uncovered interest parity holds), then changes in relative supply would not affect the exchange rate. But under imperfect substitutability, the exchange rate adjusts as investors demand compensation to shift their portfolio holdings toward the asset that has become relatively more abundant. There are reasons to be skeptical about the quantitative importance of this channel in the case of advanced economies, where bond markets are so huge that even massive intervention barely makes a dent on the relative supply of assets (Ghosh, 1992). In the case of EMEs, however, interventions can amount to a significant share of local bond markets, and this channel can be stronger.

The signaling or expectation channel affects the exchange rate through a change in market expectations about future fundamentals (including the stance of monetary policy). If the central bank has better information about fundamentals (which is certainly the case, at least regarding the future stance of monetary policy), then intervention can be perceived as a signal of future exchange rate movements. Unlike the portfolio balance channel, it is not clear *a priori* whether this channel should be stronger in EMEs or advanced economies.

Stone et al. (2009) survey intervention practices as of late 2007, including in 14 inflation-targeting EMEs. Excess volatility is a motivation for intervention in eight of those EMEs, with three others having volatility-related motives (e.g., stabilize foreign exchange markets, maintain orderly conditions, and maintain exchange rate stability). Other common motives include reserve management (e.g., accumulation of reserves for prudential reasons) in five EMEs, managing the exchange rate so as to help achieve the inflation targets in two EMEs, managing the exchange rate within a band in two cases, and signaling in one EME. Adler and Tovar (2011) survey official central bank statements for the motives of intervention in 15 economies, with a focus on Latin America. The two reasons most often stated are building international reserve buffers and containing exchange rate volatility. Only one country stated that slowing the speed of appreciation was a motive.

There are few empirical studies on the effectiveness of sterilized intervention specifically in EMEs; several individual country studies are surveyed in Disyatat and Galati (2005).[8] Guimarães and Karacadag (2004), using intervention data from Mexico and Turkey, find that foreign exchange sales have a small but statistically significant effect on the level of the exchange rate in Mexico, but not in Turkey; they also find that such intervention reduces exchange rate volatility in Turkey (but not in Mexico). Although methodological differences across studies makes comparisons difficult, on the whole, evidence that such intervention can

[8] BIS Paper no. 24 (2005) has a series of background papers and contributed papers from different central banks from a conference of Deputy Governors hosted by the BIS on foreign exchange market intervention.

affect the *level* of the exchange rate tends to be weaker than evidence that it can affect exchange rate volatility, but for both, most studies find at least some impact (Table 3).

The effectiveness of sterilized intervention is also likely to depend upon the circumstances. Kamil (2008) finds that interventions were effective in affecting the exchange rate in Colombia when done during a period of monetary easing (although the quantitative effects were small and short-lived), but not during a period of overheating and monetary tightening. Stone, Walker and Yosuke (2009) show that sterilized intervention in Brazil in the immediate aftermath of the global financial crises helped stabilize market expectations of exchange rate volatility. Adler and Tovar (2011) estimate the effect of intervention on a panel of 15 economies, with a focus on Latin America. They find that interventions can slow the pace of appreciation. Interventions are less effective in countries with more open capital accounts, and more likely to be effective in the context of already 'overvalued' exchange rates.

Overall, the evidence on the effectiveness of sterilized intervention in EMEs is mixed, but generally more favorable than in the advanced economy context. The very fact that many, if not most, EME central banks undertake sterilized intervention suggests that at least they believe it to be effective in their own currency markets. Moreover, in assessing effectiveness, it is important to bear in mind the policy goal. To the extent that intervention is successful in reducing volatility and limiting short-run movements, this may be all that is required to help counter the effects of temporary surges in capital inflows to EMEs. Accordingly, in what follows, we assume that the central bank has available both its policy interest rate and sterilized intervention as effective instruments.

Table 3. Studies on Sterilized Intervention in Emerging Market Economies

Study	Country	Effectiveness on	
		Level	Volatility
Stone, Walker, and Yosuke (2009)	Brazil	Yes	Yes
Tapia and Tokman (2004)	Chile	Yes	
Mandeng (2003)	Colombia		Yes (mixed)
Kamil (2008)	Colombia	Yes (weak)	Yes
Holub (2004)	Czech Republic	Mixed	
Disyatat and Galati (2005)	Czech Republic	Yes (weak)	No
Barabás (2003)	Hungary	Mixed	
Pattanaik and Sahoo (2003)	India	Yes (weak)	Yes
Rhee and Song (1999)	Korea	Yes	
Domaç and Mendoza (2002)	Mexico and Turkey	Yes	Yes
Guimarães and Karacadag (2004)	Mexico and Turkey	Yes (weak)	Mixed
Abenoja (2003)	Philippines	Mixed	Yes (mixed)
Sangmanee (2003)	Thailand	No	
Adler and Tovar (2011)	Mainly Latin America	Yes	

V. Inflation Targeting and Foreign Exchange Intervention

Given its objectives of maintaining low inflation and avoiding large movements in the exchange rate away from medium-run equilibrium, what is the best policy regime for an emerging market central bank? While fully discretionary monetary and exchange rate policies allow maximum flexibility, they can also send confusing signals about central bank objectives that may ultimately undermine policy credibility. For this reason, the central bank may opt for an IT regime, subordinating its monetary policy to achieving the inflation objective. If, as the discussion above suggests, EME central banks also have available a second instrument (foreign exchange intervention), they can also limit temporary movements of the exchange rate without prejudicing attainment of their primary target, the inflation rate.

Building on the discussion from section II, here we consider how the central bank would respond to various shocks in a small open economy model of an emerging market economy with imperfect capital mobility, such that capital flows respond positively to the interest differential (taking account of any expected appreciation of the currency), but at a finite pace.

The central bank's objectives, which are assumed to be the same regardless of the policy regime, are threefold: to minimize the deviation of inflation from its target, to minimize the output gap around the economy's "potential" level of output, and to minimize the deviation of the exchange rate from its level implied by medium-term fundamentals. The latter reflects concerns about competitiveness on the appreciation side, and balance sheet risks of unhedged foreign currency exposure on the depreciation side.[9] In addition, recognizing that there are costs to holding reserves, the central bank is assumed to minimize its accumulation of excess reserves (relative to the coverage required for country-insurance purposes).

Under discretionary policies, the central bank is unable to commit not to try to inflate the economy above its non-accelerating inflation potential; a measure of the central bank's (lack of) credibility is the public's perception of its incentive to do so. The latter, which imparts an inflationary bias and which the central bank is assumed to take as given, is modeled as depending on the inflation performance of its economy. Under IT, by contrast, the central bank commits to a "lexicographical" ordering of objectives such that its inflation target is always met (in the sense that target and expected inflation are equal). This keeps inflationary expectations firmly anchored throughout, so there is no inflationary bias under IT.

With this setup, it is possible to trace through the central bank's reaction to various shocks under alternative policy regimes. In the Online Appendix, we provide analytical solutions for the key results in a simple two-period version of the model, as well as comparing all four policy regimes: discretionary monetary policy with or without FX intervention, and IT with or without intervention. Here we focus on the comparison of the two IT regimes: with and without FX intervention in a dynamic version of the model (presented in Box 1).

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[9] The central bank's objective can be specified as penalizing the (log) level deviation of the real exchange rate or its rate of change. Though conceptually distinct, it makes little qualitative difference to the simulations as in either case the central bank seeks to limit the movement of the exchange rate. The reported simulations assume the targeting of the level of the real exchange rate around the value implied by medium-run fundamentals.

We begin by considering the impact of a positive aggregate demand shock, equivalent to one percentage point of output, that occurs in period 1 and dies out gradually (see Figure 1). In the face of such a shock, the monetary authorities would naturally react by raising the policy interest rate. Comparing the interest rate response across regimes shows that the central bank would raise interest rates by more when it also intervenes in the FX market (red line) than when it does not (black line). Higher policy interest rates, which help counter the demand shock, also lead to capital inflows, putting upward pressure on the currency. If the central bank can intervene in the FX markets, then it is able to raise interest rates by more than if it does not intervene. Moreover, despite raising interest rates by less when it does not also intervene, the central bank must tolerate a more appreciated currency. Although reserves initially increase, they subsequently decline, eventually returning to their baseline value (normalized to zero). As such, the optimal policy does not imply sustained one-way intervention, but instead both sales and purchases of reserves along the adjustment path.

In the face of a capital inflow shock (modeled as a decline in foreign interest rates, which is gradually reversed; see Figure 2), the central bank would lower the policy interest rate, thereby reducing the incentive for capital to cross the border. Again, comparing the interest rate response across regimes shows that the central bank would lower interest rates by less when it also intervenes in the FX market. This is because in the absence of intervention—the only instrument the central bank has to dampen incentives for capital inflows—is to lower policy rates. But despite the lower policy interest rate, the central bank is forced to accept a more appreciated exchange rate (relative to that warranted by medium-term fundamentals) when it does not intervene in the FX market.[10] And again, intervention is two-way: initial purchases of FX, followed by sales, with no net steady-state change in the stock of reserves.

Moreover, regardless of the shock, the IT framework ensures that the central bank meets its inflation target, so intervention does not prejudice meeting the target. But without FX intervention, in both cases the central bank must tolerate a more appreciated currency (and, conversely, with negative shocks, a more depreciated one), lowering welfare relative to its objective of keeping the exchange rate close to its fundamental value. Thus, even though intervention itself is assumed to be costly, the welfare implication is clear: having both the policy interest rate and FX intervention as instruments dominates having only the policy rate. Moreover, as discussed in the Online Appendix, because the economy exhibits divine coincidence, the welfare gain from the flexibility of fully discretionary monetary policy (as opposed to IT) is small, and if the central bank's credibility is fragile, may even be negative. The more important gain comes from having the second instrument, FX intervention.

Is this a general result? The answer is yes, though the extent of the welfare gain from having the intervention instrument depends on the nature and characteristics of the capital inflows. Two parameters are key: the interest rate sensitivity of capital flows (γ_r) and the persistence

[10] A further comparison is between IT and discretion. As shown in the Online Appendix, under discretionary policies, the central bank reduces the policy rate more aggressively, but intervenes less aggressively, ending up with a larger output gap but less real exchange rate appreciation. In each case, the level of foreign reserves returns to its baseline value (normalized at zero), so neither shock calls for one-way sustained intervention.

Box 1. A Simple Dynamic Model of an Emerging Market Economy

To simulate policy responses, we adopt a dynamic version of the simple EME macro-economic model laid out in the Online Appendix. All variables are expressed in logs, except for *ca*, which is defined as the current account balance as a ratio to the foreign liability position, *k*; all parameters (Greek letters) are positive. Capital flows are specified as a partial adjustment process, converging to a finite stock for a given expected return differential:

$$\Delta k_t = \gamma_r (r_t - r_t^* + E_t \Delta e_{t+1}) - \gamma_k k_{t-1}$$

Where *e* is the real exchange rate (an increase is an appreciation), *r* and *r** are the domestic and foreign real interest rates. In a world without frictions, the capital stock should adjust instantaneously, arbitraging away any expected return differential. But we assume uncovered interest rate parity (UIP) does not hold (as is the case in practice, where if anything, a currency tends to appreciate in the presence of an interest rate differential, the *forward premium puzzle*).

The foreign real interest rate follows an AR(1) process: $r_t^* = \rho_r r_{t-1}^* + \eta_t$

The current account is given by: $ca_t = -\phi_e \, e_t - \phi_y \, y_t$

The balance of payments (BOP) equation is given by: $ca_t + \Delta k_t = \sigma \Delta R_t$ (where σ=*R/k*).

The Phillips curve for domestic inflation is given by: $\pi_t = \beta E_t \pi_{t+1} + \kappa y_t$,

Aggregate demand (the IS curve) depends on the real exchange rate and the real interest rate:

$$y_t = -\varphi_r r_t - \varphi_e e_t + u_t,$$

where the shock is an AR(1) process with parameter ρ_u. The central bank's objective function depends on the output gap, inflation, the deviation of the real exchange rate from its multilaterally-consistent level (normalized to zero), and the deviation of reserves from their optimal steady-state level (say based on country-insurance metrics):

$$\min_{r,R} EPDV\ ((y_t - \overline{y}_t^e)^2 + a\pi_t^2 + be_t^2 + cR_t^2)$$

where $\overline{y}_t^e$ is the public's estimate of the central bank's inflationary bias. We calibrate the model assuming the following initial ratios and parameters:

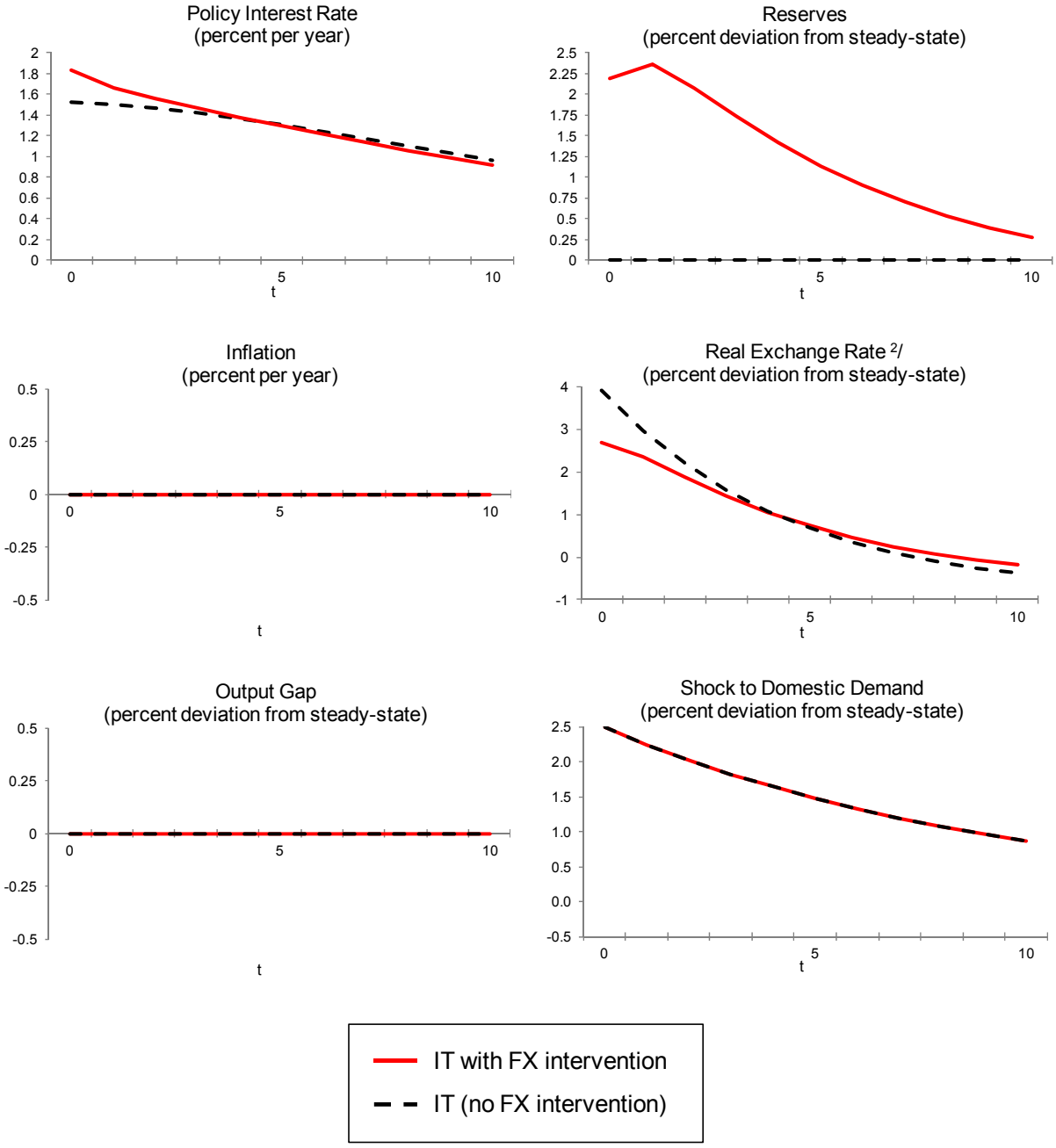
$\phi_\varepsilon = 0.15; \gamma_r = 1; \gamma_k = 0.5; \alpha = 1; \sigma = 0.5; \beta = 0.99; \rho_{r^*} = 0.75$

$\phi_y = 0.3; \varphi_r = 1; \varphi_e = 0.25; \rho_u = 0.75$

$a = 1; b = 0.1; c = 0.01$

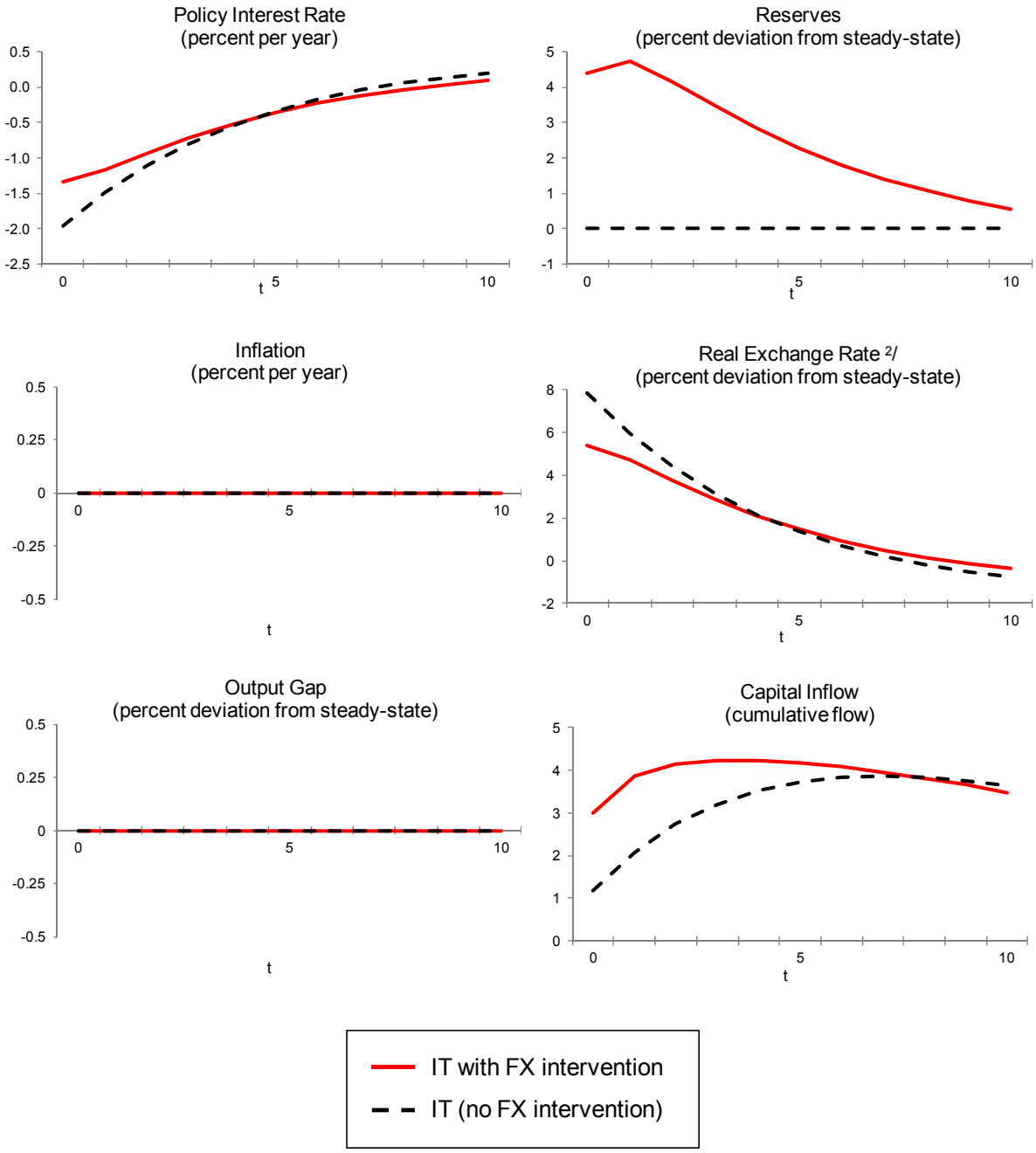
Finally, in the discretionary policy regimes, the public sector's estimate of the inflation bias is calibrated so as to generate inflationary expectations equal to 0.9 times the previous period's inflation rate, and set equal to zero in the IT regimes.

Figure 1. Policy Response to a Demand Shock [1/]



[1/] The shock is based on a 2.5 percentage point increase in domestic demand.
[2/] An increase in the exchange rate is an appreciation of the domestic currency.

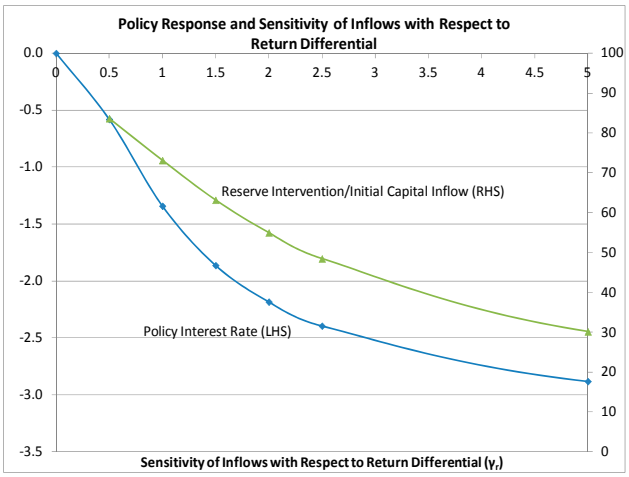
Figure 2. Policy Response to a Capital Inflow Shock[1/]



[1/] The capital inflow shock is based on a 5 percentage point decline in the world interest rate.
[2/] An increase in the exchange rate is an appreciation of the domestic currency.

of capital inflows (which depends on ρ_{r^*}). As capital flows become more sensitive to the return differential, sterilized intervention becomes more difficult (a given quantity of intervention has a smaller impact on the exchange rate); in the limiting case of perfect capital mobility ($\gamma_r \to \infty$), sterilized intervention becomes impossible.

Not surprisingly, therefore, greater sensitivity of capital flows to the return differential means that the central bank must tolerate a higher real appreciation and—proportional to the capital flow—undertake less intervention (text chart). The absolute amount of reserve accumulation is non-monotonic in the return sensitivity of capital flows, γ_r. When this sensitivity is small, the initial change in reserves is also small (since the return differential has little implications for inflows). As γ_r increases, FX intervention initially increases, but eventually starts to decline (since intervention becomes ineffective as $\gamma_r \to \infty$).



Conversely, the greater the responsiveness of capital flows to the return differential, the more the policy rate is lowered. In other words, as the economy moves toward the limiting case of perfect capital mobility and asset substitutability, the central bank must increasingly rely on interest rate changes rather than FX intervention to influence the exchange rate.

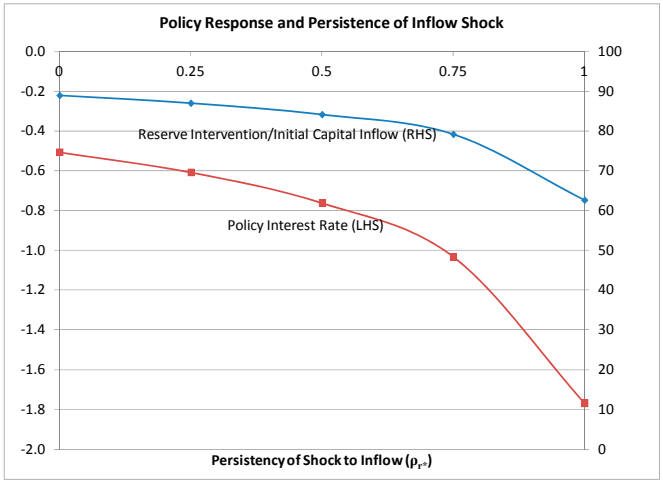
The simulations take the rate of return sensitivity of capital flows as given and constant across regimes; in practice, it may vary with the policy regime. In particular, greater certainty on the part of investors that they will obtain a higher rate of return would likely increase the sensitivity of capital flows to the return differential. It is noteworthy in this regard that, in most of the simulations (including those depicted here), the response to a capital inflow shock is to allow a jump in appreciation of the real exchange rate (albeit smaller than in the absence of intervention) followed by a gradual depreciation. In other words, the optimal intervention typically does not offer investors a sure expected appreciation—precisely because doing so would induce greater capital inflows, which is what the central bank wants to avoid. Nevertheless, the regimes with FX intervention generally imply somewhat higher and more persistent expected returns compared to the regimes without FX intervention.[11]

It is possible, therefore, that knowing the central bank had adopted a policy regime that included FX intervention (and therefore higher and more persistent returns in the event of capital inflow shocks), investors would become more responsive to the return differential (an

[11] For example, the expected return (inclusive of the interest rate differential and expected depreciation) over periods 1–10 averages 2.1 percent under IT with FX intervention, and 1.8 percent under IT without intervention.

increase in γ_r), rendering sterilized intervention less effective.[12] To reduce this tendency, some uncertainty in the central bank's intervention policy—when, how much, and at what exchange rate level—may be useful (though in deciding how much "randomness" to incorporate in its intervention policy, the central bank needs to be mindful of its impact on the real economy). In particular, the central bank should not be viewed as defending a specific level of the exchange rate, and should be perceived as willing to let it depreciate when inflow pressures abate. Such short-run volatility in the return to investors can help counteract the perceptions of one-way bets.[13]

The other key parameter is the persistence of the capital inflows. The less persistent the shock to the foreign interest rate, the less persistent the inflows that would occur in the absence of any policy response, and the smaller the policy response. The key insight of this experiment, however, is that—as a percentage of the initial capital inflow—the initial intervention (i.e., accumulation of reserves) is *greater* when inflows are expected to be *less* persistent. In fact, the degree of intervention (as a percentage of initial inflows) is monotonically decreasing in the expected persistence of the inflows (text chart). Moreover, when the shock is more persistent, the policy interest rate will be lowered by more, thus playing a larger role relative to FX intervention. This accords with the usual intuition that the authorities should allow the economy to adjust to permanent shocks (including capital inflows) but intervene to absorb temporary shocks that move the economy away from its medium-term equilibrium.



The discussion above pertains to capital inflows, though many of the same arguments apply to when there are outflows (the response to an outflow shock is the mirror image to the response to an inflow shock of a similar magnitude). In the face of temporary capital outflows, the central bank would raise policy interest rates to keep the output gap at zero (and inflation at its target level), raising them more aggressively in the non-FX intervention regime. Despite the more aggressive interest rate policy, the central bank would need to

[12] The converse is also possible: if capital inflows are responding to self-fulfilling expectations about exchange rate appreciation, then knowledge that the central bank would intervene to limit the appreciation might reduce capital inflows (and hence the need for actual intervention).

[13] Randomization can be costly to the central bank, since its loss function penalizes the volatility of reserves and of the exchange rate. Suppose the central bank has the IT regime with FX intervention and is responding to the shock in Figure 2. If it were to add a normally distributed shock to its optimal reserve policy with a standard deviation of 2.5 percent, the resulting distribution of expected returns would have a standard deviation of 1.4 percent. While this should discourage inflows, its adverse effect on welfare would be equivalent to the impact of capital inflows resulting from a further 125 basis point decrease in the world interest rate.

tolerate a larger exchange rate depreciation when it does not intervene. Again, inflation targeting keeps the output gap at zero and inflation at its targeted level.

The logic of the simulations is thus symmetric to the case of capital inflows. Yet there is one crucial difference in that the central bank can run out of reserves but there is no obvious limit to how much it can accumulate in the face of inflows. When it comes to outflows, therefore, it is particularly important to distinguish between temporary shocks and more persistent outflows, financing the former but relying more heavily on the policy interest rate for the latter (or just letting the currency depreciate). As discussed above, moreover, if the central bank is perceived as defending a specific parity, this could encourage greater carry trade to take advantage of interest rate differentials (since downside risk for investors would be limited). As in the case when there are capital inflows, an inflation-targeting central bank should only intervene when there are movements of the exchange rate that are clearly away from medium-run equilibrium. But, for the reasons outlined above, if anything, the central bank will want to be especially cautious before intervening in the FX markets (as opposed to just raising interest rates) in the face of outflows, unless these are sufficiently large and abrupt (and perhaps more reflective of developments in capital-sending countries) that they threaten severe economic dislocation. Moreover, in this case, it may be preferable to on-lend foreign exchange to unhedged borrowers facing FX exposure in the case of temporary outflows, rather than to intervene in the FX market. In practice, of course, central banks are likely to find it challenging to gauge the persistence of capital flows in real time, given their dependence on a host of factors, including global risk aversion and the behavior of monetary policy in industrial countries.

VI. Multilateral Considerations

The discussion above suggests that lowering the policy interest rate and absorbing part of the inflow through foreign exchange intervention is the appropriate response to a capital inflow shock. That discussion, however, does not take account of multilateral considerations. These are twofold. First, better coordination of monetary policies across capital-sending and capital-receiving countries can reduce the magnitude of the capital inflow shock. Second, coordination of monetary policies across capital-receiving EMEs, the focus of the discussion here, can result in superior outcomes.

A common intuition is that uncoordinated policies would result in attempts to excessively depreciate the exchange rate in order to gain competitive advantage. But that intuition turns out to be incorrect when capital account shocks dominate the balance of payments, and the shock to which EMEs are reacting is a surge of capital inflows. Rather than wishing to "export" unemployment via a depreciated exchange rate (as in a model centered on current account considerations), countries in the capital-flows-centered model seek to "export" capital inflows through a combination of excessively low interest rates and too little FX intervention (the latter allowing the exchange rate to get overly strong, thus making domestic assets relatively expensive and deterring inflows).

Clearly, if capital flows to each recipient country were completely independent of the flows to other countries, then there would be no need for coordination of policies in EMEs. More realistically, however, policy actions in one EME might deflect (some component of) the flow to another recipient. And even if this is not the case in fact, when choosing its monetary

and exchange rate policy response, each EME might believe that it will be able to deflect the capital flow toward another country.

Indeed, as can be shown in a simplified multicountry version of the model above (Online Appendix), uncoordinated discretionary monetary policies will result in too low interest rates, too little reserves accumulation, and excessive appreciation of EME currencies. Each central bank, acting on its own, would seek to lower interest rates and allow its currency to appreciate by more than those of other recipient countries, as both policies reduce the rate of return to investing in the country, thus deflecting part of the capital flow to others. In equilibrium, of course, since each recipient country faces similar incentives, there is little or no actual deflection of the capital inflow. Nonetheless, this means that the uncoordinated equilibrium is characterized by lower policy interest rates and less sterilized intervention than coordinated monetary and exchange rate policies would imply.

From this result, the benefits of the inflation-targeting-cum-intervention are apparent. Recall that inflation targeting without FX intervention involves lowering the policy interest rate by more than it would when the central bank also intervenes (Figure 2). The IT-cum-intervention regime is thus closer to the coordinated equilibrium (both in terms of interest rate policy and, trivially, intervention policy) than IT without FX intervention. In fact, policies under the IT-cum-intervention regime also come closer to those under policy coordination than do uncoordinated discretionary monetary and exchange rate policies. As such, IT-cum-intervention regimes can bring the cross-country configuration of exchange rates closer to their multilaterally-consistent global equilibrium. This is a significant benefit of the IT-cum-intervention regime given the formidable informational requirements (such as which countries were experiencing shocks, what is their persistence, etc.) necessary to implement internationally coordinated policies, and the lack of global mechanisms to enforce them (see Ghosh and Masson, 1994).

VII. CONCLUSIONS

Monetary authorities in EMEs often lack the full policy credibility that comes from successfully achieving prolonged periods of price stability. As such, inflation targeting has proven to be an increasingly attractive option to help anchor expectations and generate low inflation. At the same time, early adopters of IT and present day inflation targeters among the advanced countries have generally adopted floating exchange rates in part to avoid potential conflicts between price-stability and exchange-rate objectives. Should EME inflation targeters do likewise?

The answer we give in this note is that, because of well-known structural features of EMEs, benign neglect of large exchange rate movements that are inconsistent with the multilateral medium-run equilibrium are unlikely to be the right policy even under an IT framework. If two policy instruments are available (the policy interest rate and foreign exchange market intervention), then they should be used in tandem to achieve both price-stability and exchange-rate objectives. In fact, to foreswear the use of the second instrument in the face of potentially wild swings in currencies (including those due to volatile capital flows) might actually serve to undercut rather than boost credibility since at some point a commitment to

non-intervention in the FX market would itself not be plausible if the exchange rate strayed too far from the level consistent with fundamentals and the preservation of macro stability.

When the central bank is seeking to entrench its commitment to low inflation in the eyes of the public, a two-instrument IT framework may yield significant benefits. Specifically, while discretion is a viable option when policy credibility is high, an IT framework can help to anchor inflationary expectations when credibility is imperfect. Provided use of the second instrument is subordinated to the achievement of low inflation, macro stability (low output gap and inflation, stable real exchange rate around the level consistent with fundamentals) will be easier to achieve. In response, for instance, to a destabilizing increase in capital inflows, the central bank can both lower the policy rate and intervene in the FX market to limit appreciation, in much the same way as it would do under unconstrained full discretion, but while avoiding the inflationary bias that would otherwise result from discretionary policies. Far from being reticent to use the second instrument, central banks should embrace its use as being fully consistent with the IT framework.

Intervention to limit appreciation may give rise to multilateral concerns when push factors in source countries are giving rise to excessive inflows across a broad swath of EMEs. But as recipient countries seek to deflect inflows to other countries, they will have a tendency to allow their assets to become more expensive through appreciation rather than depreciation of their currencies. A cooperative equilibrium will result in more foreign exchange market intervention to limit appreciation in inflow recipient countries. A two-instrument IT framework will get the world closer to the cooperative equilibrium than a situation where each country operates under unconstrained discretion, thus bringing the global configuration of exchange rates closer to their multilaterally-consistent levels. This is a potentially important side benefit of the two-instrument IT framework relative to the unconstrained Nash equilibrium—not least because the informational requirements to implement discretionary but coordinated policies in real time would be formidable.

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