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Chapter 4

Monetary Policy, International Liquidity and Central Bank Balance Sheet in Emerging Market Economies

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Abstract

Although a number of emerging market economies have recently adopted inflation targeting, their relatively large foreign exchange reserves and frequent exchange market interventions suggest that the monetary authorities remain concerned about sudden reversals of international capital flows and large swings in exchange rates. This paper shows that large stocks of foreign exchange reserves and frequent exchange market interventions expose the balance sheet of the central bank to the type of risk that is beyond its control and can generate undesirable macroeconomic outcomes, a problem that can be further complicated by the bank's desire to avoid interference from the government. The paper then discusses an institutional design for the management of exchange rates and foreign exchange reserves, stressing the need for a broad but explicit policy guideline, a clear division of labor between the central bank and the government, and consistency between internal and external policy goals.

Keywords: emerging markets, central bank independence, central bank balance sheet, inflation targeting, foreign exchange reserves, exchange market intervention

1. Introduction

A series of currency crises in the late 1990s and the early 2000s have forced a number of emerging market economies (EMEs) to abandon fixed exchange rates and to reconsider their monetary policy strategy. Many countries have since strengthened the institutional and policy autonomy of the central bank and introduced a policy framework that sets domestic price stability as the central policy goal. Given the sensitivity of their economies to external shocks, however, many countries remain wary of sudden reversals of international capital flows and associated swings in exchange rates. Their concern is reflected in their relatively large foreign exchange reserves and frequent exchange market interventions (Ho and McCauley 2003; Aizenman and Lee 2005).

Although there are a number of studies on the management of exchange rates and external liquidity in EMEs, these studies tend to focus on a relatively narrow range of topics, such as the effectiveness of exchange market intervention and the fiscal cost of holding international reserves. Most studies implicitly assume that the central bank and other branches of the government share a common policy objective and pay relatively little attention to such issues as who decides the timing and the method of exchange market intervention, how and by whom reserves are funded and managed, and most importantly, whether these operations are consistent with domestic monetary policy. In EMEs, moreover, the central bank tends to exercise substantial discretion concerning the ways in which exchange market intervention and foreign reserve management are conducted, making it difficult for outsides to assess, for example, whether the government is satisfied with its job.

When the central bank accumulates large foreign exchange reserves, and particularly if these reserves are used actively for exchange market intervention, its balance sheet and accounting income becomes unstable. Although the central bank's fiscal loss does not have the same meaning as those of commercial banks, large fluctuations in its income may have undesirable implications for its monetary policy. For example, if the central bank worries that instability of its balance sheet invites interference from the government, it may attempt to protect its fiscal position by adjusting the target of its domestic monetary policy in a manner that is socially suboptimal.

This paper considers the ideal division of labor between the central bank and the government in foreign exchange management and exchange market intervention. Whilst our analysis is applicable to a variety of circumstances, it is particularly pertinent to EMEs, as these are the countries most exposed to capital account shocks and whose central bank is less shielded from political influence

than in advanced countries. As we shall see, the long-term inflation rate of a country, the amount of its foreign reserves, and the way in which seigniorage is shared by the central bank and the government are related to one another on the balance sheet of the central bank and cannot be determined independently. Furthermore, the relationship among these variables can be complicated by the central bank's desire to fend off external interference and may be manipulated in a manner that is socially undesirable. One way of avoiding such an outcome is for the government to establish a basic guideline concerning foreign reserve management and exchange market intervention and to agree to finance parts of these operations. Once such a guideline has been agreed upon, the government may also find it in its interest to relegate the bulk of actual policy implementation to the central bank and to concentrate on monitoring its performance.

The rest of this paper is organized as follows. The next section reviews reserve management practices and exchange market intervention in a sample of countries and show that many EME central banks indeed face considerable financial risk. Section 3 analyses how a country's inflation target, foreign exchange holdings, and the manner in which seigniorage revenues are distributed between the central bank and the government influence the dynamics of the central bank's fiscal position. Section 4 extends this analysis to a situation in which exchange rates deviate from the equilibrium value and examines how capital gains and losses on foreign exchange reserves can influence its monetary and reserve management policies. Using these analyses as a point of departure, Section 5 then discusses what is necessary to ensure that exchange rates and the external liquidity of a country are managed properly without undermining domestic price stability. Section 6 summarizes the discussion of the paper.

2. Monetary policy, official international reserves, and exchange market intervention in emerging market economies

In recent years, a number of EMEs have changed the anchor of their monetary policy from the external value of their currencies (the exchange rate) to their domestic value (the inflation rate). This policy shift has often been accompanied by increased institutional and operational independence of the central bank and the introduction of a relatively transparent policy framework such as inflation targeting (IT). In many EMEs, however, the monetary authorities remain active in the foreign exchange market and act as the guardian of foreign exchange reserves. This section reviews the way in which these operations are conducted, and how

these operations relate to domestic monetary policy, focusing on IT countries.[1]

According to the most recent version of the IMF's A*nnual Report on Exchange Arrangements and Exchange Restrictions* (AREAER), 22 countries use IT as their monetary policy framework. Table 1 lists these countries, together with information about each country concerning the IT adoption date, the exchange rate regime, and the size of official international reserves. As one can see, the list includes 15 EMEs, although some countries' IT has only a short history. According to the same volume of AREAER, close to half of these countries maintain an exchange rate regime other than clean floating, in contrast to the seven industrial countries that all float their currencies. The table also shows each country's de facto exchange rate regime reported by Levy Yeyati (2005). Although this classification should be regarded as tentative, it also indicates that not all IT countries adopt a hands-off approach to the external value of their currencies. A recent study also reports that the majority of EMEs on this list have intervened in the foreign exchange market at least once after IT was introduced (Ho and McCauley 2003). Whereas purists might insist that IT central banks should engage in no exchange market intervention, this is evidently not what is found in most EMEs.[2]

In many EMEs listed in Table 1, central bank independence and IT were introduced rather hastily in the wake of a serious external financial crisis, partly from the necessity to establish an alternative monetary anchor quickly but often also in response to pressures from international financial organizations such as the IMF to do so. This contrasts with most industrial countries in which both central bank independence and a rule-based monetary policy have been instituted after extensive discussion and a much longer preparation period. In EMEs, therefore, the central bank cannot sit idly on its newly gained independence but needs to demonstrate its desirability to the government and the general public. Given the relative sensitivity of their economies to external shocks and the fact that their independence has partly been a windfall from past currency crises, it is not surprising that the central banks of EMEs remain concerned about external factors. As shown in the rightmost column of Table 1, most IT EMEs indeed hold comparatively large foreign exchange reserves as ratio of domestic economic activity.

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[1] Although this section focuses on IT countries, the analyses of the following sections are relevant to any country in which the central bank is granted a degree of policy autonomy and targets a particular inflation rate, either formally or informally.

[2] Even in IT industrial countries, the central bank often reserves expressly the right to intervene in the foreign exchange market for purposes other than price-level stabilization. See Chiu (2004) for intervention practices in industrial countries.

Table 2 shows the size of each central bank's net foreign-currency assets in relation to other major items on its balance sheet. Although direct cross-country comparison is difficult, one finds that net foreign currency assets exceed both the stock of currency and base money in the majority of EMEs, sometimes by a factor of three to four. In comparison with foreign assets, moreover, the central bank's broadly defined capital (sum of paid-in capital, statutory reserves and provisions) is often small and even negative in some countries. These observations imply that many central banks finance foreign exchange assets by issuing interest-bearing debt and incur exchange rate risk, although some countries appear to hedge part of such risk using off-balance sheet transactions.

Whilst interest is growing in the central bank's fiscal risk,[3] whether this is an issue with meaningful *macroeconomic* implications is not self-evident. For example, one might argue that, since the central bank can ask the government for financial support in times of a serious fiscal loss, what ultimately matters for a country's monetary policy is not the central bank's balance sheet but the consolidated balance sheet of the central bank and the government (Meltzer 1999). As stressed by Stella (2004) and Ueda (2004), however, this text-book view misses political-economy aspects of central banking. Although the central bank's accounts may not matter much if its fiscal loss is automatically covered by the government, very few central banks enjoy such a privilege. It should be recalled that the whole issue of central bank independence rests on the assumption that the government is, when left on its own, prone to pursuing a socially undesirable inflation rate.[4] This assumption in turn implies that in countries where the central bank is granted meaningful policy autonomy, there should, at least in the short run, be serious conflicts of interest between the two parties. Under such circumstances, the government is unlikely to write a blank check to the central bank but may instead see the latter's financial difficulties as an opportunity to exert its influence.[5] Recent questionnaire surveys do indeed indicate that a number of central banks are concerned about their fiscal risk and believe that a large capital loss and excessive

[3] See Hawkins (2004), Stella (2004, 2005), Dalton and Dziobek (2005) and Ize (2005, 2006).

[4] This paper treats the government as a single agent and does not make distinctions among, for example, the legislature, the executive branch and the treasury. Whilst this is obviously an over-simplification, we leave issues arising from conflicts of interests among branches of the government to future research.

[5] If the government recapitalizes the central bank by issuing government bonds, and if the central bank purchases these bonds using the transferred fund, their consolidated balance sheet remains unchanged (Ueda 2004). As will be discussed in Sections 3 and 4, however, subsequent financial flows between the two parties are very sensitive to the rule concerning the transfer of central bank income to the government and may have implications for the country's broader monetary outcomes.

income variations can lead to greater interference from the government (Pringle and Carver 2004)

One might also argue that the fiscal risk of the central bank has little implication for its monetary policy since its balance sheet has a very different meaning from those of commercial banks (Cargill 2005). As the central bank's profit arises largely from its monopoly power of currency issuance, its accounting loss at a point in time need not constrain its monetary policy as long as it earns sufficiently large seigniorage revenues in the long run. Nevertheless, the extent to which the central bank can use seigniorage as a buffer against shocks to its balance sheet depends on how its accounting surplus is shared with the government. In most countries, the central bank settles its account annually and hands in all or most of its profit to the treasury. When the bank incurs an operating loss, however, it is normally required to write it off with its reserves or to keep it in a temporary account to be settled by its future profits. When the central bank's assets are impaired seriously, it may therefore have to carry a negative capital or revaluation account for a number of years.[6]

Table 3 presents information about each IT country concerning: (a) who sets the numerical inflation target; (b) who decides foreign exchange market intervention; (c) whether or not intervention records are disclosed; and (d) how central bank income is shared with the government. According to this table, the central banks of EMEs tend to have more autonomy than do their industrial-country counterparts in the setting of the target inflation rate, albeit with varying degrees. In most EMEs, the central bank is also responsible for exchange rate policy, although this is typically a convention rather than a written rule.[7] Lastly, about half of these countries withhold all intervention records even ex post, with most other countries also disclosing only limited information.

As for the distribution of the central bank's operating surplus, two most common arrangements are: (1) a fixed proportion of its accounting surplus in each period is transferred to the government; and (2) all or most profits are surrendered to the government after fulfilling the central bank's pre-specified reserves and provisions. In most countries the central bank has little discretion over how much it retains from its income, and only in a few countries is the bank guaranteed financial support from the government in times of excess liabilities. In most EMEs, the inflation target is set at a higher level, and real money demand grows faster, than in industrial countries. Moreover, their fiscal authorities tend to have a

[6] See Dalton and Dziobek (2005) and Ize (2005) for recent examples in developing countries.
[7] In some countries, the choice of exchange rate *regime* is reserved explicitly for the government.

smaller tax base and face higher marginal costs of tax collection than in industrial countries. In EMEs, therefore, the central bank generates relatively large seigniorage as proportion to domestic economic activity, in which the government has stronger reasons to be interested.

3. Internal and external monetary management and the central bank balance sheet

In this and the next section, we examine how the domestic monetary policy of the central bank is constrained by its external concerns. This section examines a simpler case in which the exchange rate always remains in equilibrium, whereas the next section considers a situation in which exchange rate fluctuations cause temporary valuation gains and losses on the central bank's foreign assets.[8]

Let us start with the following simplified central bank balance sheet:

$$C_t + D_t + K_t = e_t F_t \tag{1}$$

where C_t denotes the central bank's net non-interest-bearing liabilities, D_t is its net interest-bearing debt, K_t is its capital, e_t is the exchange rate defined as the price of one foreign currency unit in domestic currency, and F_t is the value of net foreign assets measured in foreign currency. Although C_t includes currency in circulation and the non-remunerated deposits at the central bank of commercial banks and the government, we refer to C_t simply as "currency" as this is typically the most important and stable part of non-interest-bearing liabilities of the central bank. Similarly, although we define K_t broadly as the central bank's paid-in capital, statutory reserves and revaluation accounts, it will be simply called "capital" in order to avoid confusion with foreign exchange reserves. Taking the first difference of eq. (1), one finds

$$\Delta C_t + \Delta D_t + \Delta K_t = e_t \Delta F_t + \Delta e_t F_{t-1} \tag{2}$$

This equation holds in any $t = 1, 2, \ldots$, where each *t* represents the central bank's accounting period, which is typically one year.

We assume that the central bank settles its accounts at the beginning of each year and divides its operating income with the government in accordance with a pre-specified rule. Its income for year $t-1$, which is determined at the beginning of year *t*, can be computed as follows:

[8] Part of the analysis in this section draws on Ize (2005).

$$\Omega_{t-1} = i_t^* e_t F_{t-1} + \Delta e_t F_{t-1} - i_t D_{t-1} - O_{t-1} \tag{3}$$

where i_t and i_t^* denote the home and the foreign nominal interest rates for assets held between the beginnings of years $t-1$ and t, whereas $O_{t\text{-}1}$ represents the operating expenditures incurred by the central bank during $t-1$. $\Delta e_t F_{t-1}$ corresponds to a revaluation gain or loss on its foreign exchange reserves.[9]

We assume that the central bank is authorized to maintain a certain amount of capital as a cushion against various risks to its balance sheet. Whilst the size of the central bank's capital and provisions varies across countries, the fact that its income arises mainly from seigniorage suggests that C_t is unlikely to grow or shrink unboundedly relative to the other variables in eq. (1). We therefore assume that the central bank is permitted to build its own capital up to a fixed multiple of currency. It we let $k^* \geq 0$ denote this multiple, the preceding assumption implies $K_t \leq k^* C_t$ and hence $K_t / C_t \leq k^*$. As k^* corresponds to the maximal ratio of capital to currency, we call it the *maximum capital ratio*. In years when the central bank incurs an operating loss, it makes no transfer to the government but receives no reverse transfer from the latter.[10] These assumptions imply the following dynamics of the central bank capital:

$$\Delta K_t = \begin{cases} k^* C_t - K_{t-1} & \text{if} \quad \Omega_{t-1} \geq k^* C_t - K_{t-1} \\ \Omega_{t-1} & \text{if} \quad \Omega_{t-1} < k^* C_t - K_{t-1}. \end{cases} \tag{4}$$

If the government has the power to decide the maximum capital ratio k^*, what value does it choose? To examine this question, let us first rewrite all balance sheet items in eqs. (1)-(4) in terms of ratio to currency. If we let small letters represet these values (e.g. $d_t = D_t / C_t$), eqs. (1) and (2) can be expressed as:

$$1 + d_t + k_t = e_t f_t \tag{5}$$

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[9] Central banks are often allowed to exclude unrealized gains and losses on their foreign assets from their regular profit and loss statement and to keep them in a special revaluation account. In such a case, $\Delta e_t F_{t-1}$ bypasses Ω_{t-1} and adds directly to ΔK_t. See Section 5 for the merits and the problems of such an arrangement.

[10] As we saw in Section 2, some countries require the central bank to submit a portion of its income to the government irrespective of the state of its capital and reserves. This alternative transfer rule does not change the main results in this and the next sections, provided that the proportion of the transfer is not very small. Defining the maximum capital ratio in terms of proportion to the central bank's total asset (a method used in some countries) also leaves most of the following results unchanged.

$$\Delta k_t + \Delta d_t = e_t \Delta f_t + \Delta e_t f_{t-1} \tag{6}$$

The assumption that the central bank attempts to stabilize the structure of its balance sheet implies that the values of d_t, k_t, and $e_t f_t$ will remain stable in a steady state.

Next, by substituting eq. (4) from (3) for Ω_{t-1}, rewriting each term in small letters, and eliminating d_t and Δd_t using eqs. (5) and (6), we obtain

$$k_t = k^* \tag{7}$$

$$i_t + \left(1+i_t^*\right) e_t f_{t-1} - \left(1+i_t\right) e_{t-1} f_{t-1} - \left(1+\pi_t+g_t\right) k_t + \left(1+i_t\right) k_{t-1} - o_{t-1} = 0 \tag{8}$$

where π_t and g_t denote, respectively, the rates of inflation and real money growth. Rewriting $\Omega_{t-1} \geq k^* C_t - K_{t-1}$ in eq. (4) analogously, we find

$$i_t + \left(1+i_t^*\right) e_t f_{t-1} - \left(1+i_t\right) e_{t-1} f_{t-1} - \left(1+\pi_t+g_t\right) k^* + \left(1+i_t\right) k_{t-1} - o_{t-1} \geq 0 \tag{9}$$

Unless the country maintains the fixed exchange rate regime, the nominal exchange rate will change over time in accordance with changes in economic fundamentals. We assume that the equilibrium exchange rate is determined by purchasing power parity (PPP), and further assume in this section that the actual exchange rate always remains in equilibrium. If the foreign inflation rate is 0, the preceding assumptions imply $\Delta e_t / e_{t-1} = \pi_t$ and hence $e_t = \left(1+\pi_t\right) e_{t-1}$. Rearranging eq. (9) using this condition yields

$$i_t - \hat{r}_t e_{t-1} f_{t-1} - \left(1+\pi_t+g_t\right) k^* + \left(1+i_t\right) k_{t-1} - o_{t-1} \geq 0 \tag{10}$$

where $\hat{r}_t = r_t - r_t^*$ denotes the real interest rate differential between the home and the foreign countries, with $r_t = i_t - \pi_t$ and $r_t^* = i_t^* - \pi_t^* = i_t^*$.[11]

In what follows, we assume that the central bank targets the inflation rate of $\pi_t = \pi > 0$ in all $t = 0,1,2,...$ and successfully keeps the actual inflation rate at this level. For simplicity, the real interest rates in the home and foreign countries are also assumed to be stable and remain at $r_t = r > 0$ and $r_t^* = r^* > 0$. This implies that the domestic nominal interest rate is also constant at $i_t = r + \pi = i > 0$. As the home country is an EME and the foreign country is one whose currencies are held widely as international reserves (e.g. the United States), it is reasonable to assume $\hat{r} = r - r^* > 0$. Lastly, we assume that g_t and o_t also remain stable at $g \geq 0$

[11] We ignore $r_t^* \pi_t$ as this value should be small under normal circumstances.

and $o \geq 0$, respectively.

PPP implies that the nominal exchange rate e_t increases at the rate of π. Therefore, if the central bank does not want foreign exchange reserves to dominate other items on its balance sheet, it must reduce the value of f_t gradually over time (see eq. (5)). However, if we let P_t and P_t^* denote the home and the foreign price levels and define the real exchange rate and the real foreign exchange reserves as

$$s_t \equiv \frac{e_t P_t^*}{P_t}, \qquad f_t^* \equiv \frac{F_t / P_t^*}{C_t / P_t} \tag{11}$$

PPP implies $s_t = 1$ and f_t^* also remains stable as long as $e_t f_t$ remains stable. In what follows, we let f^* denote the value of f_t^* that satisfies $e_t f_t = s_t f_t^* = 1 \times f_t^*$.

Now let us return to eq. (10), the condition under which the central bank can achieve the maximum capital ratio in year *t*. If the previous year's capital was also at the maximum level, we can replace k_{t-1} by k^* and solve eq. (10) for k^*. Doing so finds

$$k^* \geq -\frac{(r+\pi) - \hat{r} f^* - o}{r - g}. \tag{12}$$

When the preceding inequality holds, the central bank should be able to keep its capital ratio at the maximum level indefinitely.

In eq. (12), the right hand side is negative if the numerator and the denominator are both positive. In such a case, any non-negative k^* satisfies the inequality condition. In most countries, the real interest rate is larger than the real economic growth rate, and the latter exceeds the growth rate of real money demand.[12] Under normal circumstances, $r - g$ would thus be positive, although the difference between *r* and *g* may not be large. Meanwhile, $(r+\pi) - \hat{r} f^* - o$ corresponds to the central bank's seigniorage revenue net of the cost of holding foreign assets and other operational expenditures. While this value should also be positive under ordinary circumstances, it can become negative if the central bank maintains large foreign exchange reserves in the presence of a substantial home-foreign interest rate spread. When $(r+\pi) - \hat{r} f^* - o$ is negative, the right

[12] Real money stock can grow faster than the real economy in countries whose economy has only recently been freed from serious financial repression. Our main focus is, however, EMEs with relatively developed financial markets.

hand side of eq. (12) as a whole also becomes negative. In such a case, the inequality condition fails if k^* is set at a very low level.

At first sight, it might look puzzling that the government becomes unable to expropriate the central bank's profit by imposing a lower ceiling on its capital. However, if the central bank reduces its capital without changing the size of international reserves, it clearly must issue more interest-bearing debt. As a rise in d_t reduces the central bank's accounting profit, the amount that it can transfer to the government also falls even though it now needs to put aside a smaller amount of profits to maintain its capital/currency ratio.

When eq. (12) is not satisfied, at what level does the central bank's capital ratio get stabilized in the long run? If we let k denote this steady-state capital ratio, its value can be found by replacing k_{t-1} and k_t in eq. (8) by k and solving it for k. This yields

$$k = -\frac{(r+\pi) - \hat{r}f^* - o}{r-g}. \tag{13}$$

As one notices immediately, the right hand side of eq. (13) is identical to that of eq. (12). The inequality condition in eq. (12) can therefore be stated alternatively as $k^* \geq k$. This in turn implies that if k^* is set below k, the central bank is unable to achieve this maximum ratio but its capital in fact ends up at k.

While the foregoing result may also look contradictory, its meaning becomes clear if one considers what would happen if the government insists on keeping k^* below k. If the government sets k^* above k, the central bank's income in each year is more than sufficient to keep its capital at this maximum level, with the balance being transferred to the government. If k^* is set at k, the bank generates income that is just sufficient to maintain its capital at k^*, with no transfer to the government taking place. If k^* is set below k, the central bank is not only unable to make any contribution to the government but also fails to maintain its capital ratio at the previous year's level. As long as k^* is kept below k, its capital ratio continues to decrease and approaches negative infinity in the long run. As this is clearly unsustainable, the government will be forced to recapitalize the central bank at some point and raise the maximum capital ratio at least up to the level at which the bank can stabilize its balance sheet by itself, which is k in eq. (13). Any $k^* < k$ is therefore not practicable unless the government is willing to recapitalize the central bank continuously.

Although the preceding result indicates that the government cannot keep the central bank's maximum capital ratio below k, it is in fact not in its interest to set it

at above k. As nominal currency grows at the rate of $g+\pi$, the central bank has to put aside $(g+\pi)k^*$ at the end of each year if it wishes to keep its capital at k^*. If the government raises the maximum capital ratio from k^* to $k^*+\Delta k$, the central bank can increase its transfers to the government by $[i-(g+\pi)]\Delta k=(r-g)\Delta k$, where $i\Delta k$ is the savings on the carrying cost of its interest-bearing liabilities.[13] From the government's point of view, however, raising the maximum ratio from k^* to $k^*+\Delta k$ is equivalent to raising its own debt by Δk. As the outstanding debt of Δk costs the government $i\Delta k$ each year, the total return to the government is $-(g+\pi)\Delta k$, which is clearly negative. Under the income sharing rule under consideration, the return to the government is therefore maximized by choosing the lowest value of k^* that the central bank can maintain by itself, which is k.

Eqs. (12) and (13) illustrate how the central bank's long-run capital is related to the inflation target and the amount of foreign reserves. In most countries, the amount of capital and provisions that the central bank can (or is required to) reserve is stipulated in the central bank law or a government directive, and generally cannot be changed by the central bank alone.[14] Nevertheless, if $i-\hat{r}f^*-o<0$ and $r-g>0$, the central bank does need a strictly positive capital to keep its balance sheet stable. In this case, k is related negatively with π and positively with f^*, implying that a lower central bank capital requires a higher inflation rate and/or smaller foreign exchange reserves. In countries where the decision on the target inflation rate is reserved for the government, the central bank has no option but to adjust the size of foreign exchange reserves. In countries where the central bank can choose the inflation target but is required explicitly or implicitly to hold a particular level of international reserves, it may find it necessary to set the target inflation rate above the socially optimal level. Worse yet, if k^* is set low *and* both the inflation target and the size of international reserves are determined by the government, the central bank has no means with which to stabilize its accounts. Such a central bank is not "independent" from the government, whatever operational autonomy it my have on paper. From the government's perspective, therefore, deciding the rule of sharing central bank income has the meaning of choosing the degree of its effective independence (Stella 2004).

Incidentally, although the preceding analysis has treated $\hat{r}$ as a constant,

[13] From the central bank's point of view, the real return on its capital is thus $r-g$, which corresponds to the denominator of the right hand side of eqs. (12) and (13).

[14] In Norway, a major valuation loss on official foreign exchange reserves in 2002 has resulted in a revision of the rule governing the distribution of seigniorage between the central bank and the government, though not in the manner originally envisaged by the central bank (Norges Bank 2003).

we acknowledge that this may not be the case in practice. In our present setting, $\hat{r}$ is not just the real home/foreign interest rate differential but also has the meaning of the risk premium on home (currency-denominated) assets. If a lower inflation rate and/or higher international reserves boost investors' confidence in home-currency assets and reduce $\hat{r}$, the adjustments of π and/or f^* required by a given change in k^* may be smaller than implied by eq. (12). However, such effects are likely to diminish once the inflation rate has fallen and the foreign exchange reserve has increased to reasonable levels.[15]

4. Exchange rate fluctuations and central bank balance sheet

This section extends the preceding analysis to situations in which the exchange rate deviates from the equilibrium value in the short run and examines how our previous results may change in the presence of temporary valuation gains and losses on official foreign exchange reserves. Whilst a fuller analysis of this issue should be conducted in a stochastic environment, we simplify our analysis by considering the following situation. Let us suppose that the nominal exchange rate obeys the following deterministic but oscillatory process:

$$e_t = \begin{cases} (1+\sigma)e_t^* & \text{if } t \text{ is odd} \\ (1-\sigma)e_t^* & \text{if } t \text{ is even.} \end{cases} \tag{14}$$

In the above, σ is a constant that satisfies $0<\sigma<1$ whereas e_t^* is the equilibrium exchange rate determined by PPP. Therefore, the central bank now incurs temporary valuation gains (losses) in odd- (even-) number years. These valuation effects, moreover, become more significant as the amount of its foreign exchange reserves and/or the exchange volatility parameter σ become larger.

Let us also suppose that, because of short-run exchange rate fluctuations, the central bank achieves the maximum capital ratio k^* in odd-number years but fails to do so in even-number years. In such a case, we observe from eq. (8) that the central bank capital in even-number years satisfies the following condition:

[15] Although this section assumed the PPP to hold indefinitely, the Balassa-Samuelson effect may be important for EMEs whose industrial sector is growing rapidly. If PPP holds only for tradable goods, f_t^* needs to increase gradually to keep $e_t f_t$ stable, adding to the effective cost of holding foreign exchange reserves. As the size of international reserves increases, moreover, so does outstanding central bank debt in the domestic financial market. If the central bank dislikes the effect of its debt on the domestic yield curve, it may have to gradually lengthen the maturity of such debt, which would also increase the carrying cost for foreign reserves.

$$i_t - \left(\hat{r}_t + \sigma_t^*\right) e_{t-1}^* f_{t-1} - \left(1 + g_t + \pi_t\right) k_t + \left(1 + i_t\right) k^* - o_{t-1} = 0 \tag{15}$$

where

$$\sigma_t^* = \sigma\left[2\left(1 + i_t\right) - \hat{r}_t\right]. \tag{16}$$

Eq. (15) indicates that the central bank capital in an even-number year, k_t, depends on the size of foreign exchange reserves in the previously year, which is f_{t-1}. The latter in turn depends on the central bank's reserve management policy and whether or not it attempts to reduce short-run fluctuations in the exchange rate. In what follows, we consider two specific examples.

Suppose first that the central bank is not concerned about temporary exchange rate fluctuations and holds foreign exchange reserves solely as insurance against extraordinary external shocks such as a sudden and massive capital flight. If the central bank does not engage in day-to-day exchange rate stabilization, it may, as in the previous case, choose to adjust the size of its reserves at the rate just sufficient to compensate for the inflation differentials between the home and the foreign countries. By doing so, the central bank can fix the local-currency value of the reserves measured at the equilibrium exchange rate, $e_t^* f_t$, and stabilize the structure of its balance sheet, in the long run.

As in Section 3, let us suppose that the central bank has the target inflation rate of π and is successful in keeping the actual inflation rate at this level. Other variables are also assumed to remain stable, such that $r_t = r$, $r_t^* = r^* < r$, $g_t = g$, $o_t = o$, $i_t = i = r + \pi$ and $\hat{r}_t = \hat{r} = r - r^* > 0$. Substituting these expressions into eq. (15) and solving for k_t, we find that the central bank's capital ratio in even-number years is

$$k = \frac{\left(1 + i\right) k^*}{\left(1 + i\right) - \left(r - g\right)} + \frac{i - \left(\hat{r} + \sigma^*\right) f^* - o}{\left(1 + i\right) - \left(r - g\right)} \tag{17}$$

where σ^* is σ_t^* in eq. (16) with i_t and $\hat{r}_t$ replaced by i and $\hat{r}$. On the right hand side of eq. (17), $1 + i$ should in general be much larger than $r - g$. When the difference between r and g is not very large, the solution in eq. (17) should roughly be

$$k \simeq k^* + \frac{i - \left(\hat{r} + \sigma^*\right) f^* - o}{1 + i}. \tag{18}$$

For simplicity, the following discussion will be conducted in terms of this approximate but simpler solution.

The preceding solution is based on the assumption that the central bank achieves the maximum capital ratio k^* in odd-number years and fails to do so in even-number years. Making use of eq. (9), we find that these two conditions are satisfied simultaneously when

$$i - \left(\hat{r} + \sigma^*\right) f^* - o < 0 \leq i - \hat{r} f^* - o. \tag{19}$$

The rightmost part of eq. (19) is identical to the numerators of the right hand side of eqs. (12) and (13). If the second inequality is satisfied, the central bank earns sufficient income in the long run to obviate the need to hold a capital. On the other hand, the first inequality holds when σ^* and/or f^* are sufficiently large, in which case k indeed becomes smaller than k^* (see eq. (18)).

In Section 2, we saw that many central banks were concerned about their fiscal risk. If a central bank believes that a serious deterioration of its financial condition threatens its credibility and independence, it might try to avoid a situation – even a temporary one -- in which its capital and provisions are wiped out by a major valuation loss on its assets. In eq. (18), we observe that for any given σ^* and f^*, k will be positive for a sufficiently large k^*. As the central bank is normally not given discretion over this variable, however, it must find some other way of protecting its balance sheet. By differentiating eq. (18) with respect to π and f^*, we find

$$\frac{dk}{d\pi} = \frac{1 + \hat{r}\left(1 - \sigma\right) f^* + o}{\left(1 + i\right)^2} > 0 \tag{20}$$

$$\frac{dk}{df^*} = -\frac{\hat{r} + \sigma^*}{1 + i} < 0. \tag{21}$$

Thus, the central bank can prevent its capital from turning negative if it can raise the target inflation rate and/or reduce the amount of foreign reserves sufficiently.[16]

[16] When f^* is reduced sufficiently as to violate the second inequality in eq. (19), not only is

As a second example, consider a situation in which the central bank wishes to ameliorate short-term exchange rate fluctuations, for fear of such fluctuations developing into a more serious and prolonged currency misalignment and/or of their effect on international trade. If the central bank intervenes in the foreign exchange market with the aim of mitigating exchange rate fluctuations, it will sell (purchase) foreign currency in odd- (even-) number years. Whereas such operations would change the central bank's reserve position, it may be concerned that excessive reserve fluctuations can also undermine foreign investors' confidence in the home economy. One reasonable strategy that accommodates both of these concerns would be to limit interventions to the point where the temporary valuation losses (gains) on foreign reserves are just compensated by the increase (decrease) in the amount of reserves arising from such interventions. By doing so, the central bank can again keep the exchange reserves measured in home currency, $e_t f_t$, and hence also the structure of its balance sheet, stable over time. With this type of leaning-against-the-wind intervention, the size of the international reserves *valued at the equilibrium exchange rate* can be expressed as:

$$e_t^* f_t = \begin{cases} (1+\sigma)^{-1} f^* & \text{if } t \text{ is odd} \\ (1-\sigma)^{-1} f^* & \text{if } t \text{ is even.} \end{cases} \tag{22}$$

where, as in Section 3, $f^* = s_t f_t^* = e_t f_t$.

As in the previous case, suppose that the central bank achieves the maximum capital ratio k^* in odd-number years but fails to do so in even-number years. It then follows from eqs. (15) and (22) that the central bank's capital in even-number years satisfies the following condition:

$$i_t - (\hat{r}_t + \sigma_t^*)(1+\sigma)^{-1} f^* - (1+g_t+\pi_t)k_t + (1+i_t)k^* - o_{t-1} = 0 \tag{23}$$

Letting $r_t = r$, $g_t = g$, $o_t = o$ as before and solving for k_t, we obtain

$$k = \frac{(1+i)k^*}{(1+i)-(r-g)} + \frac{i-(\hat{r}+\sigma^-)f^* - o}{(1+i)-(r-g)} \tag{24}$$

where

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the central bank able to avoid a negative capital but it can also maintain the capital ratio at k^* without interruptions.

$$\sigma^{-} = \frac{2\sigma}{1+\sigma}\left[(1+i) - \hat{r}\right]. \tag{25}$$

If we assume $r \simeq g$ as in the previous case, the preceding solution collapses to

$$k \simeq k^{*} + \frac{i - \left(\hat{r} + \sigma^{-}\right) f^{*} - o}{1+i}. \tag{26}$$

Eqs. (24) and (26) are identical to eqs. (17) and (18), except that σ^{*} is replaced by σ^{-}. As $\sigma^{*} > \sigma^{-}$, the values of k in eqs. (24) and (26) should be larger than the corresponding values in eqs. (17) and (18). This reflects the fact that the valuation loss in even-number years is now smaller since the central bank sells a portion of its reserves in odd-number years to resist home-currency depreciation.

As the preceding solution assumes that the central bank achieves the maximum capital ratio in odd-number years and fails to do so in even-number years, let us again check the conditions under which these events take place. Making use of eq. (9), we find that these two conditions are satisfied when

$$i - \left(\hat{r} + \sigma^{-}\right) f^{*} - o < 0 \leq i - \left(\hat{r} - \sigma^{+}\right) f^{*} - o \tag{27}$$

where

$$\sigma^{+} = \frac{2\sigma}{1-\sigma}\left[(1+i) - \hat{r}\right]. \tag{28}$$

Since $0 < \sigma^{-} < \sigma^{+}$ and both σ^{-} and σ^{+} are increasing functions of σ, the two inequality relations in eq. (27) do hold simultaneously for large values of σ and/or f^{*}. Therefore, there can indeed be a situation in which a temporary valuation loss prevents the central bank from achieving the maximum capital ratio in even-number years.[17]

As in the previous non-intervention case, k may become negative when k^{*} is

[17] If the central bank's intervention is successful in the present case, the exchange rate volatility parameter σ should become smaller than in the previous case and may further reduce the gap between k and k^{*} in eqs. (24) and (26).

sufficiently small. By differentiating eqs. (27) with respect to π and f^*, one obtains

$$\frac{dk}{d\pi} = \frac{1+\left(\sigma^- / \sigma^+\right)\hat{r}f^* + o}{\left(1+i\right)^2} > 0 \tag{29}$$

$$\frac{dk}{df^*} = -\frac{\hat{r}+\sigma^-}{1+i} < 0. \tag{30}$$

Again, these results suggest that the central bank having no discretion over the maximum capital ratio might be tempted to either raise the target inflation rate or reduce the size of foreign exchange reserves to keep its balance sheet non-negative.

Whilst the analyses in this and the last sections reveal close linkages among a country's inflation rate, foreign exchange reserves, exchange market intervention and the central bank capital, whether and how these relations are reflected in actual monetary policy making is not straightforward. Suppose, for example, that the government of a country provides its central bank with only minimum capital but substantial discretion over decisions on the domestic inflation target and the size of international reserves. If the central bank believes that choosing and achieving the socially optimal inflation target is the most effective in demonstrating its competence, it may pay little regard to external factors and be disinclined to engage in exchange market intervention even in the presence of implicit or explicit pressure from the government to do so. When, however, the central bank considers itself as responsible for both internal and external monetary conditions of the country and fears that its independence be threatened seriously in the event of a capital account crisis, it may choose to maintain very large international reserves even at the cost of a higher inflation rate. In countries where the government has a strong preference to stable exchange rates, the central bank may fear that permitting large exchange rate fluctuations would sour its relationship with the government and feel compelled to engage in extensive market intervention, even if doing so is not part of its official mandate.

5. Division of labor between the central bank and the government

Then, what institutional arrangements are necessary to ensure that a country's external liquidity and exchange rates are managed properly without causing an unnecessary strain on domestic price stability? At first sight, it might appear that

the problems discussed in Sections 3 and 4 can be resolved simply by letting the central bank hold sufficiently large capital and provisions, or by granting it the right to decide the amount of income it keeps to itself in each period. Such measures would, however, be neither realistic nor desirable. As the main source of central bank income is its right to issue currency, and as the latter is a franchise granted by the government, the government has the right, at least in principle, to all of its income. The preceding arrangement would effectively force the government to waive (significant part of) this right, which, beside the question of practicability, raises the issue of central bank governance. In Section 3, we noted that the inequality relation in eq. (12) could be made to hold without sacrificing the targets for π and f^* if the government is prepared to raise k^* sufficiently.[18] However, the same objective could also be achieved by reducing *o*, the central bank's operating expenditure. If the maximum capital ratio is set at a higher level than *k* in eq. (13), the central bank will generate larger income than necessary to keep its capital ratio at k^*, with the difference being handed over to the government automatically irrespective of its size. In such a situation, it is questionable that the central bank makes effects to minimize its expenditure, which includes payments to its own staff.[19]

Yet another possible way of ensuring the inequality in eq. (12) and avoiding a negative *k* in eqs. (19) and (27) would be to formally transfer to the government part or all of foreign exchange reserves and to relieve the central bank of the cost of carrying them.[20] In eq. (12), the inequality relation should hold even with a very low π as long as both f^* and *o* are reasonably small. Similarly, if f^* is sufficiently small, *k* in eqs. (19) and (27) should remain positive even when k^* is relatively small. Under such an arrangement, however, the government would be

[18] As in Section 3, the following discussion assumes a situation in which the numerator and the denominator of the right hand side of eq. (12) are, respectively, negative and positive.

[19] Ize (2006) provides evidence suggesting that a number of central banks face a soft budget balance.

[20] A similar outcome may be obtained not by changing the ownership of foreign reserves but merely by permitting the central bank to accumulate unrecognized capital gains and losses on its foreign assets in a special revaluation account, as is done in a number of countries. Indeed, both the central bank and the government would find such an arrangement convenient, as it would allow the former to avoid large fluctuations of its accounting income and hence also the amount it transfers to the latter. Nevertheless, such practice would make the central bank's accounts opaque and create its own problems. Having valuation gains and losses reflected in the central bank's balance sheet but not in its income statement makes sense only if these gains and losses are genuinely transitory. But how can one distinguish temporary exchange rate fluctuations from changes in the equilibrium exchange rate? Who would assume responsibility if the estimated equilibrium exchange rate turns out to be incorrect? Moreover, a revaluation account created to store unrecognized capital gains and losses is often abused for other purposes, such as concealing soured domestic assets that should be written off promptly.

required to shoulder the cost of holding reserves directly. Therefore, one has to consider whether this arrangement makes sense in the light of the purposes for which reserves are held.

Although some countries hold international reserves solely as insurance against unforeseen external shocks, other countries accumulate them for (and as a result of) exchange market interventions that are conducted in non-crisis situations to influence the ongoing exchange rate. As noted in Section 2, the international reserves of many EMEs have risen sharply in recent years. Whereas part of this increase seems to reflect the monetary authorities' conscious efforts to rebuild their reserve assets in the aftermath of a currency crisis, other parts appear to have been an inadvertent (and perhaps undesired) result of their exchange market interventions in response to acceleration in capital inflows during 2002-2004 (IMF 2005). Since not all countries engage in exchange market intervention with the same intensity, let us leave aside this part of reserves momentarily and first discuss who should hold, and bear the cost of, the reserves held as national liquidity buffers.[21]

When considering the preceding question, one needs to bear in mind the fact that a country's external liquidity cannot be secured solely by the central bank. For example, in countries where the government has accumulated large foreign currency debt and whose ability and/or intention to honor its obligation are questioned by investors, the central bank would not be able to eliminate the possibility of a sudden capital flight even if it maintains sizable international reserves. Moreover, whereas the existence of large private-sector external liabilities raises the size of official reserves necessary to ensure national liquidity, the borrowing behavior of private agents is a function of prudential regulations imposed on them. Although the central bank had traditionally engaged in both monetary policy and financial-sector supervision, a number of countries have recently transferred the latter to an independent supervision agency. Furthermore, once a serious external liquidity crisis has broken out, it is not the central bank but the government who negotiates bridging capital with foreign governments and international organizations. In other words, the ultimate responsibility for a country's external monetary relations rest with its government, and the fiscal position of the government is also an important factor in the determination of the optimal size of international reserves.[22] This in turn implies that the most suitable

[21] We admit that the distinction between the two types of reserves is not necessarily clear-cut, particularly in very small and open economies with an underdeveloped foreign exchange market, where a minor external shock can cause serious exchange rate fluctuations.

owner of this portion of foreign exchange reserves is not the central bank but the government.

On the other hand, who should hold and pay for international reserves held for exchange market intervention is less straightforward and depends critically on who formulates the country's exchange rate policy. Although the central bank decides exchange market intervention in most EMEs, the government plays a more active role in several countries (e.g. Brazil, Korea and Malaysia). In industrial countries, there are prominent examples in which the government formally or effectively monopolizes intervention policy (e.g. Canada, Japan, the United Kingdom and the United States), though the frequency of intervention tends to be much lower than in EMEs.[23]

One obvious advantage of leaving intervention decision to the government is that the central bank can concentrate on domestic price management without getting distracted by exchange rate movement. Although a number of EME central banks seem to believe that they are able to influence short- to medium-term exchange rate dynamics without sacrificing long-term domestic price stability,[24] sterilized intervention is at best a "fractional" instrument whose effectiveness depends on circumstances and is difficult to predict in advance (McCauley 2006). Times of weak effects may tempt the central bank to engage in increasingly aggressive and extensive interventions, which would hinder its domestic monetary policy and harm the natural evolution of the local foreign exchange market.

As we noted previously, moreover, exchange rate policy tends to become a source of politically charged disputes, as different industrial sectors and the politicians representing these industries have diverse interests concerning the external value of the home currency. Tasking the central bank to conduct exchange market intervention without at least a broad policy guideline may have undesirable influence on its domestic monetary policy by exposing tensions between the central bank and the government (or some part thereof) and reminding investors that central bank independence is not sacrosanct. This, however, also means that

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[22] In the wake of the Asian financial crisis, a group of East Asian countries have established a network of bilateral swap agreements to guard their economies against a temporary liquidity crisis. Although the official signatories of these swap agreements are the central banks of the participating countries, the scheme itself was conceived and initiated by their governments. Interestingly, some of the most avid promoters of the swap network, such as Japan, Korea and Malaysia, are countries where the government, not the central bank, dominates exchange rate policy.

[23] Even in these countries, most of actual interventions are conducted by the central bank.

[24] There are several reasons why exchange market intervention can be more effective in developing countries than in advanced countries, such as the monetary authorities' information advantage and relatively dominant position in the local exchange market (Mihaljek 2005; Ishii et al. 2006).

even when the government monopolizes exchange rate policy, its interventions would be subject to political haggling and become a source of uncertainty unless there is a publicly stated policy rule that constrains opportunistic behavior.[25]

Given the preceding problems, one reasonable arrangement would be that the government first formulates a general intervention guideline with the help of the central bank, and then entrusts the latter to decide and execute actual intervention. As one might notice, this arrangement is a natural extension of what many countries already practice about domestic price management and would have the additional virtue of integrating internal and external monetary operations. Whilst how precise and detailed this intervention guideline should be is open to debate, it must be broad enough not to give market participants opportunities for an one-sided bet but also specific enough to give the central bank a solid ground on which to fend off political pressures on its decision making. In countries where domestic price stability is the central bank's primary policy goal, this guideline should also include clauses that prohibit the bank from targeting a particular nominal exchange rate and that require it to make efforts to minimize its involvement in the foreign exchange market.

If intervention policy is relegated to the central bank, it is important that the government establishes a mechanism through which it monitors the central bank's operations formally and to check their effectiveness and appropriateness on a regular basis. This can be done as part of the government's broader appraisal of the bank's monetary policy and may usefully be accompanied by the disclosure of its intervention records. While most countries are reluctant to disclose their intervention records even ex post, it would be difficult for the government and the general public to judge the appropriateness of its operations without having access to accurate and reasonably detailed intervention records. Although there is a widespread belief among the monetary authorities that too much transparency in exchange market intervention impedes its effectiveness, one should remember that policy uncertainty can also become a source of market instability (Chiu 2005; Moser-Boehm 2005). Although there may be legitimate limits for *real-time* disclosure, there are less compelling reasons for keeping records even after a reasonable grace period.

If the government and the central bank agreed on the division of labor

[25] In Japan, the Ministry of Finance (MoF) manages most of the country's official foreign exchange reserves and effectively monopolizes decisions on exchange market intervention. That the ministry has no official intervention guideline and is not required to account for its intervention activity is perhaps not unrelated to the facts that its intervention tactics change frequently and that ministry officials tend to engage in more extensive and frequent interventions – both actual and verbal - than in other industrial countries (Chiu 2005).

sketched above, who should own and pay for relevant international reserves would also become less controversial. If the government recognizes that it would be ultimately held responsible in cases of an external crisis, it would be logical that the government decides the amount of, and pay for the cost of maintaining, the official reserves that are held as insurance against such an event. In practice, the desirable size of such reserves depends on a number of factors, including the probability of serious external contingencies, the expected macroeconomic cost of such contingencies, the fiscal cost of maintaining these reserves and the empirical relationship between the size of official reserves and the cost of external borrowing by the private sector. As assessing the importance of these factors requires detailed knowledge of financial markets, it would be a good idea that the government solicits advice from the central bank and reviews the appropriateness of the size and the structure of its reserves at regular intervals. Doing so would help the government and the central bank develop a common perspective on the vulnerability of their economy and a sense of camaraderie for protecting the economy from unforeseen external shocks.

As for reserves held for intervention purposes, the central bank should first formulate a practicable intervention policy in accordance with the government's general guideline, and decide the amount of foreign currency inventories necessary to execute this policy. The amount of such reserves depends not only on the central bank's intervention policy but also on a number of country-specific factors (e.g. the size and liquidity of local foreign exchange markets) and may almost certainly be larger in small EMEs than in large industrial countries. However, as long as foreign exchange markets are functioning properly, the monetary authorities might be able to reduce the effective size of such reserves through a number of methods, such as currency swaps that are utilized in a number of countries. Moreover, if interventions are conducted properly and confined to short- to medium-term smoothing operations, these interventions should in principle be profitable and pay for themselves in the long run (Friedman 1953). It would be reasonable, therefore, that the central bank assumes full financial responsibility for this segment of reserves; doing so would also help deter the bank from engaging in overly ambitious interventions at the cost of domestic monetary instability.[26]

[26] A variant of the type of arrangements discussed in this section is found in New Zealand. In 2003, the Reserve Bank of New Zealand (RBNZ) reviewed the adequacy of the country's foreign reserves and its exchange market intervention policy. The RBNZ developed a framework for computing the desirable level of reserves held for emergency purposes, and the government agreed to raise its reserves to the estimated amount using its own resources (Gordon 2005). Simultaneously, the RBNZ explicitly obtained the right to intervene in foreign exchange markets independently of the government under non-crisis circumstances. The RBNZ pledges to limit its intervention to trimming large cyclical exchange rate swings and

The carrying cost and the exchange rate risk of international reserves depend not only on their magnitude but also on how these reserves are managed. Recent studies suggest that a number of EME monetary authorities are trying to raise the returns on and/or reduce the risk of their reserve portfolios by expanding the range of assets and by reviewing their duration and currency composition (Carver 2006). Since the primary purpose of official reserves is not to seek financial returns, it is clearly inappropriate to spread their investment portfolios at the expense of their safety and liquidity. However, as the official reserves held for national insurance purposes remain unused unless there occurs a serious liquidity crisis, it might make sense to adopt a slightly more active investment strategy for this part of reserves than for those held for non-crisis intervention. Although the government may wish to manage the former portion of reserves on its own, it may benefit from establishing a basic investment guideline and delegating actual portfolio management to the central bank. Such an arrangement may indeed be unavoidable in small countries where the public sector has limited financial expertise and investment infrastructure. If this type of arrangement is adopted, however, the accounts for relevant foreign assets and domestic liabilities should be separated from the central bank's own account and excluded from its profit and loss reports.

6. Conclusion

This paper discussed the linkage between a country's internal and external monetary policies and the roles of the central bank and the government thereof, focusing on EMEs whose economies are sensitive to external events and where the central bank tends to face (or perceives that it faces) greater political-economy constraints. As we saw in Sections 3 and 4, a country's long-term inflation rate, foreign reserves and the rule according to which the central bank's income is shared with the government are mutually dependent and cannot be determined independently. Since most central banks are granted little discretion over the amount of income it retains in preparation for contingencies, it may attempt to avoid government intervention by compromising on its internal monetary objective (the inflation rate) and/or its external objectives (the size of foreign reserves and the stability of exchange rates). In the last few years, the cost of holding foreign reserves has not been a pressing issue for most EMEs because of historically low risk premiums attached to their financial assets (Genberg et al. 2005). Nevertheless, with the monetary policies of major industrial economies

take responsibility for its effect on its balance sheet (Ekhold et al. 2005). There has so far been no incidence of such intervention, however.

entering into a tightening cycle and capital flowing back to these countries, tensions between internal and external monetary policies may become more visible and acute in the near future (Goldstein 2005).

For the external monetary relations of a country to be managed to the best interest of its people, the government and the central bank need to forge consensus about basic policy objectives and make their respective roles clearer. The central bank cannot by itself ensure the country's external solvency and liquidity, and the likelihood of a serious capital flight that threatens its liquidity depends on wider government policies including fiscal management and financial-sector supervision. The government should thus develop – with appropriate technical inputs from the central bank – a framework for computing the optimal amount of this portion of reserves and finance them with its own resources. Nevertheless, as this part of reserves is drawn only under genuinely extraordinary circumstances, the government may wish to ask the central bank to manage them on its behalf in normal times to raise returns from these assets.

International reserves are also held for and as a result of exchange market intervention that aims more narrowly at managing cyclical exchange rate fluctuations. Although EME central banks typically enjoy substantial discretion over exchange rate policy, both their mandate and their actual intervention tactics often remain extremely opaque. As exchange rate movements tend to expose diverse interests of domestic agents and cause politically-charged disputes, one reasonable arrangement would be that the government establishes a broad but clear intervention guideline and leaves actual intervention decisions to the central bank. As appropriately conducted leaning-against-the-wind interventions should be profitable in the long run, the government may demand the central bank to assume full financial responsibility for such interventions in return for a sufficient degree of operational freedom. The bank should also disclose its intervention records at least after a certain time lag and regularly report to the government its own assessment of its intervention activity. Such an arrangement is akin to what is already accepted as the best practice for domestic price management and may help integrate the country's internal and external monetary arrangements.

With growing concerns about the external imbalance of the US economy and the future of the dollar, a number of EMEs are reported to be reviewing their existing reserve management policy and considering diversifying their reserves away from dollar assets to those denominated in other currencies (Genberg, et al. 2005; Carver 2006). As an abrupt policy change by the monetary authorities of one country can conceivably cause a chain reaction in other countries and may provoke extreme exchange rate gyrations, several observers propose that the monetary authorities of major foreign exchange holding countries, including those

of several EMEs, coordinate their reserve management policies by agreeing on a common investment guideline and/or by pooling portions of their reserves at an international organization (Summars 2006; Truman and Wong 2006).

Nevertheless, what we have discussed in this paper suggests that beside the issue of practicability, any *international* reserve management agreement should be preceded by a rationalization of policy and a clearer demarcation of the responsibilities between the government and the central bank *within* individual countries. If the government signs up to an internationally binding reserve investment arrangement without consulting the central bank and assessing the appropriateness of its existing reserve portfolios, such an agreement runs the risk of perpetuating an inappropriate policy and may even jeopardize the central bank's monetary policy autonomy. Moreover, once strong constraints were imposed on the size and the currency composition of their foreign exchange reserves, individual countries would find it difficult to enforce timely exchange market intervention when circumstances change rapidly. These considerations strengthen the case for a thorough review of exchange market and reserve management policies in EMEs before the international capital environment turns unfavorable.

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Table1. Exchange rate regime and foreign exchange reserves in inflation-targeting countries

Country	IT starting date[1]	Exchange rate regime (IMF)[2]	Exchange rate regime (Levy Yeyati 2005)[3]	Forex reserves as % of GDP[4]
Brazil	1999:Q2	Independently floating[5]	Float	7.4
Chile	1999:Q3	Independently floating	Float	16.3
Colombia	1999:Q3	Managed floating with no predetermined path[5]	Float	12.8
Czech Republic	1998:Q1	Managed floating with no predetermined path	Dirty float	25.2
Guatemala	2004:Q1	Managed floating with no predetermined path[7]	Dirty float / crawling peg	13.1
Hungary	2001:Q3	Pegged exchange rates within horizontal bands[6]	Float	17.9
Israel	1997:Q2	Independently floating[6, 7]	Dirty float	22.5
Korea	1998:Q2	Independently floating	Fixed	27.6
Mexico	2001:Q1	Independently floating	Float	10.4
Peru	2002:Q1	Managed floating with no predetermined path[5]	Dirty float / crawling peg	19.1
Philippines	2002:Q1	Independently floating	Dirty float / crawling peg	16.2
Poland	1999:Q1	Independently floating	Float	14.2
South Africa	2000:Q1	Independently floating	Float	8.4
Thailand	2000:Q2	Managed floating with no predetermined path	Float	31.2
Turkey	2003:Q1	Independently floating[5]	Float	15.7
Australia	1993:Q1	Independently floating	Float	6.2
Canada	1991:Q1	Independently floating	Float	2.9
Iceland	2001:Q1	Independently floating	Fix	7.2
New Zealand	1990:Q1	Independently floating	Fix	8.4
Norway	2001:Q1	Independently floating	Fix (2004, outlier)	17.5
Sweden	1993:Q1	Independently floating	Dirty float / crawling peg	6.2
United Kingdom	1992:Q4	Independently floating	Float	1.9

(Notes) [1] IMF WEO and central bank websites. [2] As of December 31, 2004. [3] De facto classification for 2004. [4] As of December 31, 2005. [5] Under IMF-supported or other monetary programs. [6] More than one monetary anchor. [7] De factor regime differs from de jure regime.
(Source) IMF World Economic Outlook (Sep. 2005), Annual Report on Exchange Arrangements and Exchange Restrictions (2005), International Financial Statistics (CD-ROM); Levy Yeyati (2005), "LYS de facto classification of exchange rate regimes, updated December 2005" (available at: http://www.utdt.edu/~ely/papers.html); central bank websites.

Table 2. Foreign exchange reserves and central bank balance sheet

Countries	As of:	(A) Official international reserves (USD million)[1]	(B) Net foreign assets on CB's balance sheet (USD million)[2]	(B) / (currency in circulation)	(B) / (currency + commercial banks' statutory reserves)[3]	(B) / (CB's capital + reserves)[4]
Brazil	Jan. 06	53,596	54,991	2.57	0.56	-7.11
Chile	Dec. 04	15,994	16,966	4.43	4.08	-7.65
Colombia	Dec. 05	13,289	14,957	1.78	1.50	2.08
Czech Republic	Dec. 05	29,352	29,354	2.51	2.37	-7.79
Guatemala	Mar. 06	3,675	4,208	2.26	1.53	10.64
Hungary	Dec. 04	15,913	14,835	1.85	1.05	23.16
Israel	Dec. 05	28,006	26,384	4.98	3.15	-38.43
Korea	Dec. 05	210,340	211,084	8.17	4.96	55.75
Mexico	Dec. 04	74,060	63,153	2.00	2.00	34.67
Peru	Dec. 04	12,237	12,368	4.49	4.48	137.25
Philippines	Nov. 05	15,764	13,969	2.61	1.88	2.97
Poland	Nov. 05	39,962	36,283	1.98	1.60	6.30
South Africa	Mar. 05	14,359	12,441	1.57	1.02	13.41
Thailand	Dec. 05	50,826	52,075	2.84	2.64	1.09
Turkey	Dec. 05	35,872	23,431	1.57	1.07	11.25
Australia	Jun. 05	41,905	47,672	1.75	1.72	6.56
Canada	Dec. 04	34,435	107	0.00	0.00	4.31
Iceland	Dec. 05	1,039	1,046	4.99	1.46	1.81
New Zealand	Dec. 05	8,893	4,004	1.50	1.20	3.40
Norway	Dec. 05	46,986	37,658	4.91	2.70	3.72
Sweden	Dec. 04	22,453	20,834	1.27	1.26	2.11
United Kingdom	Dec. 05	44,031	-985	-0.02	-0.01	-0.03

(Notes) [1] As reported to IMF. Includes gold and SDR. [2] Excludes off-balance items. [3] Includes reserves beyond statutory requirement when separate data are unavailable. [4] Includes revaluation accounts for countries where valuation gains/losses are reflected in CB's income statement.
(Source) Central bank websites and annual reports.

Table 3. Roles of the government and the central bank in monetary and exchange rate policies and the rule governing the distribution of central bank income

Country	IT set by:	Forex intervention determined by:[1]	Disclosure of forex intervention[2]	Allocation of CB profit[3]
Brazil	G[4]	CB	Yes	25% retained by CB; the remainder transferred to G
Chile	CB	CB	Yes	Up to 10% retained by CB; the rest transferred to G
Colombia	CB	CB	Yes	All transferred to G after CB's legal and statutory reserves have been established; CB has a specific reserve for exchange rate fluctuation.
Czech Republic	CB	CB	Yes	CB retain profits in accordance with the budget stipulated by G; the rest transferred to G
Hungary	Joint	CB	No	CB pays dividends to G from its annual profit or its accumulated profit reserves; G guarantees to cover losses in excess of existing reserves
Israel	G	CB[5]	Yes	All profits transferred to G unless CB registers a loss; no transfer in recent years
Korea	Joint	G	No	10% retained by CB
Mexico	CB	Jointly by CB and G[6]	Yes	All profits transferred to G after maintaining real capital
Peru	CB	CB	Yes	25% of profits go to G; the remainder retained in CB reserves until it reaches 100% of its capital. G guarantees to cover the difference between losses and reserves in the form of nonnegotiable and interest-bearing debt.
Philippines	Joint	CB	No	50% retained by CB; the remainder transferred to G[8]
Poland	CB	CB[5]	No	2% retained by CB; the rest goes to G
South Africa	G[4]	CB[5]	Yes	After paying 10% of profits to shareholders, 10% of the remainder is allocated CB's reserve fund and the rest goes to G
Thailand	CB in consultation with G	CB	No	25% of profits to CB's reserve subject to the ceiling of 100% of its capital.
Turkey	CB	CB	Yes	20% of profits to CB reserve fund; the rest are distributed according to the order specified in the CB law
Australia	Joint	CB	Discretionary[7]	G decides after consultation with CB
Canada	Joint	G[5]	Yes	All transferred to G
Iceland	Joint	CB	No	Two-thirds of profits transferred to G; one-third in case CB's capital + reserves fall short of 2.25% of its total domestic assets
New Zealand	Joint	CB in accordance with a framework agreement with G	Yes	A pre-specified amount retained by CB in accordance with a 5-year Funding Agreement between CB and G; the remainder goes to G
Norway	G	CB[5]	Yes	Profits retained in CB's Adjustment Fund until the latter reaches 40% of international assets with currency exposure
Sweden	CB (must inform G in advance)	CB	No	CB transfers to G 80% of the average profits of previous 5 years, excluding exchange-rate and gold revaluation effects
United Kingdom	G	G[5]	Yes	25% of profits to G; CB is charged for tax on the remainder

(Notes) G = Government; CB = Central Bank. [1] In some countries, CB decides intervention policy while G chooses regime. [2] Extent and promptness of disclosure vary across countries. [3] Some CBs show forex reserves on their balance sheets but exclude revaluation gains/losses from profit/loss accounts. [4] New law/amendment being considered. [5] No discretionary intervention in recent years. [6] Determined by the Foreign Exchange Commission composed of CB and Ministry of Finance officials (the latter prevail in case of disagreement). [7] Past interventions disclosed and analyzed by CB officials. [8] G taxes CB on its properties and profits from its activities, including open market operations.
(Source) Chiu (2003), Hawkins (2004), Moser-Boehm (2005), Tukadhar (2005) and central bank websites.