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Managing international reserves: how does diversification affect financial costs?[1]

As reserve accumulation has gathered pace in recent years, and as foreign exchange (FX) reserve holdings have risen far above conventional measures of reserve adequacy, a vigorous debate has begun as to whether part of the reserves should be invested in riskier assets to reduce their financial costs. Estimates from hypothetical reserve portfolios of selected emerging market economies over the period 1999–2007 suggest that the reduction in financial costs from holding riskier assets would generally have been small relative to GDP. Accounting practices and profit distribution rules are likely to play an influential role in asset allocation decisions.

JEL classification: G11, G18, G28.

Since the early part of this decade, official reserves held by emerging market economies have grown rapidly, and exceeded $4.5 trillion as of the third quarter of 2007. Such FX reserves must commonly be financed by domestic currency liabilities. In many emerging economies, the interest on domestic currency liabilities tends to be higher than that earned on the central bank's foreign currency assets. Consequently, central banks often incur a running loss from carrying low-yielding FX reserves on their balance sheets. Furthermore, any appreciation of the domestic currency against the foreign reserve currencies reduces the value of reserve assets in local currency terms.

As the absolute cost of holding FX reserves has increased with size, the return on the reserves themselves has attracted growing public attention (Summers (2006)). In particular, fiscal revenues can be lower if profits available to be transferred from the central bank to the government decline. Partly in an attempt to reduce the net financial costs of holding larger reserves, some central banks have broadened the range of assets in which FX reserves are invested. Such diversification might not only improve returns but could also mitigate portfolio risks. Nevertheless, the investment universe considered by most central banks is still dominated by fixed income securities, and the management of FX reserves continues to be rather conservative.

[1] The author thanks David Archer, Claudio Borio, Piti Disyatat, Dietrich Domanski, Már Gudmundsson, Frank Packer and William White for useful comments. The views expressed are those of the author and do not necessarily reflect those of the BIS.

This special feature attempts to inform the reserve diversification debate by examining the following three questions. First, for a set of 12 emerging market countries over 1999–2007, how might greater allocation to longer-duration bonds and/or equities have affected the returns and volatility of their FX reserves? Second, how significant were these return differences relative to the GDP of the examined countries? Third, how might central bank objectives and institutional constraints, such as profit transfer arrangements, influence the portfolio choices of central banks?

The rest of this article is organised as follows. The first section sets out the framework used for the analysis. The second documents the returns and volatility of different notional portfolios, representative of possible central bank choices. The third assesses the returns net of the financing cost (the overall "financial cost") for the various portfolios in relation to GDP, taking into account the actual size and evolution of the reserves. The fourth discusses the asset allocation choice in the light of the existing institutional arrangements in central banks. The final section concludes.

Framework of the analysis

The asset allocation decision can be thought of as the result of the maximisation of a given objective function subject to a set of constraints. For FX reserves, one way of formulating the returns objective could be to minimise the net financial cost arising from holding reserves. An important constraint is that the volatility of returns be kept to some acceptable level, partly in order to avoid large fluctuations in central bank profits or capital.

Both returns and their volatility are a function of the numeraire currency (unit of account) in which they are computed. Choices of numeraire appear to range considerably among central banks, from that of a single foreign currency (typically the US dollar), to a basket of currencies (eg the Special Drawing Right (SDR)) or the domestic currency. The choice of numeraire should ultimately depend on the uses to which the reserves are to be put and on the institutional factors affecting the risk tolerance of the reserve manager (Borio et al (2008a)). For example, if reserves are to be used to finance emergency imports, then an argument could be made for a numeraire that corresponds to a basket of such imports.

Domestic currency is used as the numeraire

As the topic under investigation is the potential reduction in financial costs due to diversification of reserves into riskier assets, the domestic currency is used as the unit of account. There are at least two additional reasons why the domestic currency might be adopted as numeraire. First, the central bank might be concerned about the impact of fluctuations in the value of reserves on its profitability, profit transfers to the government and capital, since these are invariably measured in domestic currency. Second, the reserves could be viewed as domestic wealth whose value is to be maximised.[2]

[2] See Borio et al (2008a) and McCauley (2008) for further discussion of the choice of numeraire. The view of reserves as domestic wealth has made notable inroads since a number of countries have accumulated significant "excess reserves", above those required for

Since detailed data on the composition of reserve portfolios by country are not publicly available, this paper will examine notional (hypothetical) portfolios only. We choose as a "benchmark" portfolio one which is representative of a "conservative" asset allocation. In this case, it is assumed that reserves are invested entirely in government securities with a one- to three-year maturity, or a duration of roughly 1.8 years. In most central banks, the portfolio duration of FX reserves lies between nine months and 2.5 years, so that the one- to three-year government securities sector is reasonably representative of actual central bank portfolio choices.

Conservative benchmark portfolio …

Two less "conservative" portfolios are then considered. The first differs from the benchmark portfolio only in terms of a longer duration of the government securities. This portfolio is assumed to mirror the one- to 10-year maturity sector, which has an average duration of roughly four years. The second alternative portfolio allows investments in all traded government bonds (one- to 30-year sector) such that duration exposure is roughly six years, and in addition includes a 20% exposure to equities. Such a portfolio would be broadly representative of pension fund investments, although the share of equities in pension funds will typically be somewhat higher still. Data used in this study to support the analysis are based on total returns on major stock market indices as well as on government bond market indices.

… is compared to alternative portfolios

Some assumptions are also needed concerning the currency composition of the portfolios. For each of the above portfolios, three different currency compositions are considered, meant to be representative of choices normally made by central banks. The first assumes that the currency composition of the sample countries' reserves generally follows that of developing countries as disclosed in IMF data, which implies an average US dollar exposure of 65%;[3] the second assumes a higher share of US dollars of 80%, indicative of dollar-pegging countries; and the third assumes a more balanced currency composition, in line with that of the SDR basket, with a dollar share of around 40%.[4]

Assumptions about currency composition

The sample period for the analysis is 1999–2007. This covers the years following the Asian crisis, when rapid reserve accumulation took place. It is arguably long enough to provide useful insights about performance, given the frequency with which strategic asset allocation decisions are reviewed. At the same time, care must be taken when drawing conclusions, since ex post returns can often be poor predictors of future realised returns. That said, in many asset allocation deliberations, historical performance is used as an important input into the analysis.

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liquidity purposes. McCauley also cites empirical evidence suggesting that the domestic currency has been gaining ground as the numeraire in recent years.

[3] The US dollar share in the currency composition of developing countries' reserves has varied from 71% in 1999 to 61% in 2007.

[4] The currency composition of the SDR basket has evolved from 43% US dollars, 28% euros, 17% Japanese yen and 12% pounds sterling in 1999 to 39% US dollars, 39% euros, 11% Japanese yen and 11% pounds sterling in 2007.

The sample of countries considered includes 12 emerging market economies: Algeria, Brazil, China, India, Korea, Malaysia, Mexico, Nigeria, Russia, South Africa, Taiwan (China) and Thailand. The choice of sample is motivated by two considerations: to provide a good geographical coverage, and to include major countries that have accumulated reserves rapidly since 2000.

Risk-return trade-offs

Portfolio volatility is dominated by exchange rates

Reserve portfolios are generally not hedged against currency risk. Returns and volatility of returns measured in domestic currency therefore tend to be dominated by exchange rate movements. Thus, as a preliminary step, to better highlight the characteristics of individual asset classes, we eliminate the return and volatility component of returns resulting from exchange rate movements. We do so by comparing the annual return, volatility and return per unit of volatility risk of the various notional portfolios using the currency composition of the respective portfolio as numeraire. The results are shown in Table 1.

While estimated returns increase for those notional portfolios that take on riskier assets, they do so less rapidly than volatility, so that returns per unit of volatility decline. For example, the extension of duration for the bonds by four years and the addition of 20% equities reduces the return per unit of risk by roughly a factor of two. A conclusion one can draw from this exercise is that, ignoring currency effects, central banks would have increased volatility more than returns by taking on additional duration and equities during the period. Of course, it must also be remembered that this inference is based on comparisons of different notional portfolios, for a specific sample of countries, and over a limited time period.

The results differ considerably when incorporating the exchange rate component of returns and volatility. Tables 2 and 3 show the annual returns and volatility of returns of various notional portfolio compositions for each of the different emerging market economies in the sample using their domestic currency as the numeraire. Over the period of the study, excess returns over the benchmark portfolio between 0.4% and 1.2% would have been secured with relatively little increase in volatility (and in some cases even a reduction). Again, these results are calculated over a specific time period, and would not necessarily predict future performance well.

Risk-return characteristics of portfolios measured in different currency baskets

1999–2007, in per cent

	One- to three-year sector bonds			One- to 10-year sector bonds			20% equities + 80% bonds[1]		
	DEV[2]	FIX[3]	SDR[4]	DEV	FIX	SDR	DEV	FIX	SDR
Annual returns	4.2	4.5	3.9	4.8	5.0	4.4	5.0	5.0	4.9
Annual volatility	1.7	1.9	1.5	3.1	3.3	2.8	4.0	4.2	3.6
Return/volatility	2.5	2.4	2.7	1.5	1.5	1.6	1.3	1.2	1.3

[1] Equities refer to the local stock market indices, such as the S&P 500 or EURO STOXX 50, and bonds refer to the one- to 30-year sector of the government bond market. [2] Composition of currency reserves of developing countries. [3] Fixed weights of 80% US dollars, 15% euros and 5% pounds sterling. [4] Composition of the SDR basket.

Sources: IMF; Bloomberg; JPMorgan Chase; author's calculations. Table 1

Local currency returns and excess returns of different portfolios

Annual averages in per cent, 1999–2007

	Total returns			Excess returns over one- to three-year sector bond portfolio					
	One- to three-year sector bonds			One- to 10-year sector bonds			20% equities + 80% bonds[1]		
	DEV[2]	FIX[3]	SDR[4]	DEV	FIX	SDR	DEV	FIX	SDR
Algeria	5.5	5.2	5.7	0.5	0.4	0.5	0.9	0.8	1.2
Brazil	5.9	5.5	6.1	0.5	0.4	0.5	0.9	0.8	1.2
China	3.9	3.6	4.1	0.5	0.4	0.5	0.9	0.7	1.1
India	4.5	4.2	4.7	0.5	0.4	0.5	0.9	0.7	1.1
Korea	2.2	1.9	2.4	0.5	0.4	0.5	0.9	0.7	1.1
Malaysia	3.7	3.4	4.0	0.5	0.4	0.5	0.9	0.7	1.1
Mexico	7.0	6.7	7.3	0.5	0.4	0.5	0.9	0.8	1.2
Nigeria	8.8	8.4	9.0	0.5	0.4	0.5	1.0	0.8	1.2
Russia	5.6	5.3	5.8	0.5	0.4	0.5	0.9	0.8	1.2
South Africa	6.6	6.3	6.8	0.5	0.4	0.5	0.9	0.8	1.2
Taiwan, China	5.1	4.8	5.7	0.5	0.4	0.5	0.9	0.7	1.1
Thailand	4.1	3.8	4.3	0.5	0.4	0.5	0.9	0.7	1.1

[1] Equities refer to the local stock market indices, such as the S&P 500 or EURO STOXX 50, and bonds refer to the one- to 30-year sector of the government bond market. [2] Composition of currency reserves of developing countries. [3] Fixed weights of 80% US dollars, 15% euros and 5% pounds sterling. [4] Composition of the SDR basket.

Sources: IMF; Bloomberg; JPMorgan Chase; author's calculations. Table 2

Financial cost of acquiring reserves through FX intervention

The analysis so far has considered the returns and risks associated with various portfolios without taking into account how these portfolios have been financed. Ultimately, what matters is the net return, or conversely, the net financial cost, ie the costs of financing the reserves minus the return on the reserves. This difference is referred to as the "financial cost" of reserves, and is the focus of the analysis that follows.

The bulk of the reserves held by most emerging market countries have been acquired through sterilised intervention and hence have typically been financed through issuance of domestic securities. In this case, the financial cost of reserves to the central bank would be the interest cost required to service the domestic currency liabilities less the investment income (including capital gains and losses) from the reserve holdings measured in domestic currency.

In calculating the financial cost figures, the assumption made here is that the FX reserves are financed by three-month bills issued by the central banks in the domestic currency.[5] FX reserve assets (excluding gold) reported on a

[5] The assumption that reserves are fully backed by domestic currency liabilities is a reasonable one for a number of emerging market countries, but there are notable exceptions. For example, in the case of Russia, a substantial part of the FX reserve accumulation is done through taxation of oil revenues rather than issuing domestic currency bonds. Moreover, a significant proportion of government liabilities includes foreign currency debt. Hence, the estimate of the financial costs under the assumptions made here must be interpreted with caution.

Volatility of benchmark portfolio and excess volatility of riskier portfolios

Annual averages in per cent, 1999–2007

	Benchmark portfolio			Increase in volatility when riskier portfolio is held[1]					
	One- to three-year sector bonds			One- to 10-year sector bonds			20% equities + 80% bonds[2]		
	DEV[3]	FIX[4]	SDR[5]	DEV	FIX	SDR	DEV	FIX	SDR
Algeria	4.4	4.7	4.4	0.7	0.8	0.6	1.5	1.4	1.5
Brazil	21.2	21.1	21.8	0.2	0.3	0.1	–1.2	–1.1	–1.2
China	3.3	2.6	4.9	0.8	1.1	0.3	1.3	1.7	0.7
India	5.1	5.1	5.8	0.4	0.5	0.1	0.2	0.4	0.0
Korea	9.5	9.6	9.6	0.3	0.4	0.1	–0.9	–0.7	–1.2
Malaysia	3.4	2.7	4.9	0.7	1.0	0.2	1.0	1.4	0.6
Mexico	8.5	7.7	10.0	0.4	0.5	0.1	0.5	0.7	0.2
Nigeria	6.5	6.2	7.4	0.4	0.5	0.1	–0.0	0.1	–0.1
Russia	5.2	5.3	5.7	0.4	0.5	0.2	0.2	0.2	0.3
South Africa	17.8	18.4	17.0	–0.0	0.0	–0.2	–0.8	–0.7	–0.9
Taiwan, China	5.7	5.9	6.0	0.7	0.8	0.4	0.1	0.3	–0.3
Thailand	7.5	7.7	7.8	0.4	0.5	0.2	–0.2	0.0	–0.5

[1] Increase in volatility relative to the one- to three-year sector bonds. [2] Equities refer to the local stock market indices, such as the S&P 500 or EURO STOXX 50, and bonds refer to the one- to 30-year sector of the government bond market. [3] Composition of currency reserves of developing countries. [4] Fixed weights of 80% US dollars, 15% euros and 5% pounds sterling. [5] Composition of the SDR basket.

Sources: IMF; Bloomberg; JPMorgan Chase; author's calculations. Table 3

quarterly frequency and three-month deposit rates have been used to compute the financial cost for each quarter and then aggregated to determine the annual cost of holding FX reserves. A more detailed discussion of the methodology used to estimate the financial cost of reserves is described in the box.

To provide some perspective on the economic significance of alternative portfolio choices, the financial cost estimates are presented as percentages of nominal GDP. Table 4 reports results for the period 1999–2007, first in terms of the financial costs of the one- to three-year sector benchmark "conservative" portfolio, and then in terms of the reduction in financial costs compared to the benchmark portfolio offered by the two alternative return-oriented portfolios. Both the estimated financial costs for the benchmark and the estimated reduction in costs for riskier portfolios are presented for each of the three currency compositions described above.

Fairly limited cost savings when riskier assets are held

On balance, these ex post estimates of the financial costs of reserves over the period 1999–2007 suggest that altering the asset and currency composition of the reserve portfolio for selected emerging market countries would have produced cost savings that, while sizeable in absolute terms, would have been fairly limited in relation to the size of the respective economies. Key observations from Table 4 are as follows:

- For the benchmark portfolio, estimates of the annual financial costs of FX reserves across the selected emerging market economies average to between 0.0% and 0.3% of GDP, depending on the assumed currency composition of reserves.

Methodology for computing estimates of financial cost

The financial cost for the FX reserves, estimated in domestic currency terms, will be equal to the domestic borrowing costs minus the income earned on the reserve assets (interest income plus capital gains or losses). Our methodology for computing these estimates is described below.

We assume that at the beginning of each quarter the reserve currency composition is rebalanced and invested to replicate the chosen investment benchmarks. Suppose investments in the *i*th foreign currency contain *m* benchmarks to be replicated. These benchmarks could comprise government bonds, stocks or other asset classes. Denoting the allocation to each of these benchmarks by W_{ik} and their total return index values at time *t* by $I_{ik}(t)$, the index value of the investments in the *i*th reserve currency at time *t*+1 is given by

$$I_i(t+1) = I_i(t) \times \left(\sum_{k=1}^{m} w_{ik} \frac{I_{ik}(t+1)}{I_{ik}(t)} \right)$$

At the end of each quarter, the domestic currency value of the investments made in the *i*th reserve currency will depend on two variables: the total return (capital gains plus interest income) on the benchmark index and the return from exchange rate changes. Suppose $A_i(t)$ denotes the local currency equivalent amount invested in the ith reserve currency at time *t* and $S_i(t)$ denotes the domestic exchange rate of the *i*th reserve currency, ie the number of domestic currency units required to purchase one unit of the reserve currency. Then at time *t*+1, that is, one quarter ahead, the value of this investment in domestic currency terms will be

$$A_i(t+1) = A_i(t) \times \frac{I_i(t+1)}{I_i(t)} \times \frac{S_i(t+1)}{S_i(t)}$$

The investment income from the *i*th reserve currency during the quarter measured in domestic currency terms will be given by

$$Income_i(t+1) = A_i(t+1) - A_i(t)$$

The total income in domestic currency terms on the reserve assets will be the sum of the incomes on each reserve currency holding and is given by

$$Income(t+1) = Income_{USD}(t+1) + Income_{EUR}(t+1) + Income_{JPY}(t+1) + Income_{GBP}(t+1)$$

On the liabilities side of the balance sheet, taking the total reserves at time *t* to be $A(t)$ and the three-month domestic interest rate to be $R(t)$, the interest expense is given by

$$Expense(t+1) = 0.25 \times A(t) \times \frac{R(t)}{100}$$

If GDP(*t*+1) denotes nominal GDP at current prices in domestic currency terms, then the financial cost during one quarter as a percentage of GDP is given by

$$FinancialCost(t+1) = 100 \times \frac{Expense(t+1) - Income(t+1)}{GDP(t+1)}$$

The annual financial cost as a percentage of GDP will be the sum of these costs over four consecutive quarters. It is useful to note here that a positive value for the financial cost would indicate that holding reserves involves a net income loss under the assumption that the reserve assets are fully backed by domestic liabilities. Similarly, a negative value for the financial cost would amount to an income gain for the central bank.

- A notable exception is Brazil, whose annual financial costs over the period 1999–2007 are estimated as close to 1% of GDP. This can be attributed to the high domestic interest rates in Brazil along with a substantial appreciation of the Brazilian real since 2003.
- For a number of countries, holding foreign exchange reserves may actually have provided an additional source of government revenue; that

Holding FX reserves has been a source of revenue for some countries

is, net financial costs are estimated to have been negative over the period. These countries include Algeria, South Africa, Taiwan (China) and Thailand.[6]

- On average, estimates of the financial costs of reserves are not greatly affected by changes in their currency composition. For many countries, alternative currency compositions (eg shifting from an 80% dollar share to the SDR basket, or from the second to third columns in Table 4) would have resulted in a reduction in estimated financial costs of less than 0.2% of GDP.
- The impact on financial costs of diversifying the asset mix to include equities and extend duration varies across countries. On the one hand, moving from short-dated bond holdings to a portfolio with extended duration and a 20% exposure to equities would have reduced the estimated financial costs for China, India, Korea and Malaysia over the period by between 0.3% to 0.6% of GDP. The estimated financial costs for Brazil, Mexico and South Africa, on the other hand, would have declined only marginally given a similar shift in asset composition (0.0% to 0.1% of GDP).

While the above financial cost estimates were measured relative to the size of the domestic economy, diversification benefits might also be measured

Estimates of average annual financial cost and its reduction for riskier portfolios

As a percentage of nominal GDP, 1999–2007

	Financial cost (benchmark)			Change in financial cost when riskier portfolio is held[1]					
	One- to three-year sector bonds			One- to 10-year sector bonds			20% equities + 80% bonds[2]		
	DEV[3]	FIX[4]	SDR[5]	DEV	FIX	SDR	DEV	FIX	SDR
Algeria	–0.8	–0.6	–1.1	–0.3	–0.3	–0.3	–0.6	–0.6	–0.6
Brazil	1.0	1.1	1.0	–0.0	–0.0	–0.1	–0.1	–0.1	–0.1
China	–0.0	0.1	–0.2	–0.1	–0.2	–0.1	–0.4	–0.4	–0.4
India	0.3	0.4	0.2	–0.1	–0.1	–0.1	–0.3	–0.2	–0.3
Korea	0.4	0.5	0.3	–0.1	–0.1	–0.1	–0.3	–0.2	–0.3
Malaysia	0.2	0.3	0.0	–0.2	–0.2	–0.2	–0.6	–0.5	–0.6
Mexico	0.2	0.3	0.2	–0.0	–0.0	–0.0	–0.1	–0.1	–0.1
Nigeria	1.1	1.2	1.0	–0.1	–0.1	–0.1	–0.2	–0.2	–0.2
Russia	0.7	0.8	0.6	–0.1	–0.1	–0.1	–0.7	–0.7	–0.7
South Africa	–0.1	–0.1	–0.1	–0.0	–0.0	–0.0	–0.0	–0.0	–0.0
Taiwan, China	–1.3	–1.0	–1.6	–0.4	–0.3	–0.3	–0.8	–0.8	–0.9
Thailand	–0.1	0.0	–0.2	–0.2	–0.2	–0.2	–0.3	–0.2	–0.3

[1] Computed relative to the financial cost of investing in the one- to three-year sector bonds. [2] Equities refer to the local stock market indices, such as the S&P 500 or EURO STOXX 50, and bonds refer to the one- to 30-year sector of the government bond market. [3] Composition of currency reserves of developing countries. [4] Fixed weights of 80% US dollars, 15% euros and 5% pounds sterling. [5] Composition of the SDR basket.

Sources: IMF; Bloomberg; JPMorgan Chase; author's calculations. Table 4

[6] As mentioned earlier, financial costs for Russia are significantly lower than the estimates here because reserve accumulation has been sterilised through taxation rather than issuing debt. For Nigeria, it is less clear to what extent reserve accumulation has been funded through surplus oil revenues.

in relation to the size of the central bank balance sheet. Central banks' credibility as regards reserve management, and to some extent their independence, might be adversely affected when large profit swings are reported. Consequently, the volatility of the revenue stream of central banks may need to be considered when the merits of alternative asset allocation choices are debated. In practice, accounting treatment of profits and losses determines how the volatility flows through the income statement. The next section discusses this and provides some perspectives on how accounting practices might influence the composition of reserves.

Central bank objectives and FX reserve allocation

The objectives and constraints of central banks, and hence the optimal asset composition of FX reserve portfolios, differ from those of institutional investors such as pension funds. While in principle the three objectives that central banks trade off in their reserve allocation decisions – safety, liquidity and return – are similar, the overarching goal of securing monetary and financial stability deeply influences their reserve management decisions, which remain subordinate to it. Indeed, it is precisely in the pursuit of this goal that central banks are typically structurally exposed to very large amounts of exchange rate risk: this is a policy decision that reserve management takes as given.

The main implication of this overarching aim is that central banks tend to favour liquidity and safety over return, and therefore be averse to volatility, which in turn can inhibit return-seeking behaviour. Here, the domestic governance environment and the central bank's relationship with the government and the body politic can play a significant role (Borio et al (2008b)). Especially if higher volatility – and hence even temporary losses – results from seeking higher returns, the central bank may come under closer public scrutiny and see its reputation at risk. Moreover, rules for profit remittances to the government may reinforce this aversion to volatility. While such rules vary widely, they tend to be asymmetric: profits are remitted but losses do not lead to automatic recapitalisation of the central bank (Ferhani (2007)). In this context, higher volatility of returns available for distribution increases the likelihood that central bank capital is eroded over time. This, in turn, may be perceived as undermining the central bank's budgetary, and thus possibly also operational, independence. Additionally, in some countries an advance estimate of the profit remittances to the government may need to be provided. Such a practice is also likely to constrain central banks from investing in riskier assets whose income stream cannot be predicted with the required level of confidence.

Profit remittances are asymmetric

More return-oriented investment strategies across asset classes may also be discouraged by arrangements that only selectively buffer the impact of volatility in returns on reported profits. It is not uncommon for central banks to exclude the unrealised gains on foreign exchange from the income statement (Bakker (2007)). Exchange rate effects are further moderated by maintaining a currency revaluation account to absorb some of the FX valuation losses. By

contrast, provisions to buffer the non-FX-related volatility arising from market movements on bonds and other assets are generally more limited.[7]

Conclusions

Estimates of the financial costs of holding FX reserves in the period 1999–2007 for a sample of emerging market countries suggest that the reduction in financial costs from extending duration and diversifying into equities would have been sizeable on average in absolute terms, but generally small relative to GDP. In addition, the debate on the diversification benefits of FX reserves into riskier asset classes cannot ignore the broader institutional arrangements, including the fact that central banks are likely to face significant public scrutiny of their investment performance, and concerns about capital losses and independence.[8]

In circumstances where reserves have been built up through quasi-fiscal surpluses that represent national wealth or through a transformation of non-renewable commodities into financial assets, the cost-benefit analysis might lead to different conclusions because funding costs are not involved. Managing such reserves can be done more in the spirit of "real money" managers or endowment funds. A possible remedy to reduce income volatility for the central bank could be to transfer the riskier assets to stabilisation funds or sovereign wealth funds with a mandate quite different from the management of FX reserves.

The financial costs discussed in this paper provide a very narrow definition of the overall costs associated with FX reserve holdings. Intervention to resist exchange rate appreciation may involve a consideration of macroeconomic costs and benefits that are of greater importance than the financial cost of the reserves themselves. Nevertheless, central banks have been constantly seeking ways to improve their reserve management practices and governance frameworks, and the focus on achieving beneficial risk-return trade-offs from a more structured investment process is likely to increase going forward.

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[7] In fact, many central banks mark down their bond prices to market, if this is lower than the price at which the bond was acquired, while price appreciation is not reflected in the accounting profits until the bond is sold or has matured.

[8] Further, the potential benefits of broadening the asset universe would also need to be weighed against the necessary investments in infrastructure, resources and organisational arrangements needed to support the implementation of new strategies. See, for instance, Borio et al (2008a) for a discussion on the operational framework of FX reserve management.

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