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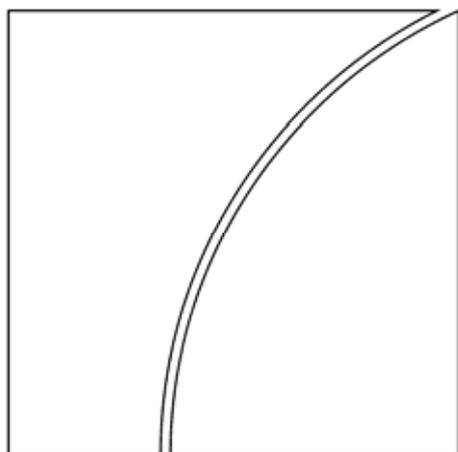
# FX reserve management: trends and challenges

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Monetary and Economic Department

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This paper draws on background material prepared for an ad hoc meeting on “Challenges in FX reserve management” held on 1–2 March 2007 and revised and updated in mid-2007. The paper is closely related to its companion piece, “FX reserve management: elements of a framework” (BIS Papers no 38), and was the basis for the closing lecture at the 3rd CEPR Conference of Past, Present and Policy entitled “Foreign exchange reserves and the international monetary system: Genoa and beyond” held in Genoa, Italy on 27–28 March 2008. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

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## Foreword

The increasing size and concentration of official foreign exchange reserves after years of continued expansion, especially since the Asian crisis, have led to renewed interest in the way reserve management decisions are taken and in their possible impact on financial markets. Reserve management practices have evolved substantially over the past decade or so, reflecting changes in both the economic and the broader institutional environment. While some of these changes have been remarked upon, others have attracted less attention. This paper documents some of the main changes in foreign exchange reserve management practices, considers the main drivers behind them, and explores some of the challenges ahead. We focus, in particular, on those challenges that could have a more significant impact on financial markets. These include the choice of an appropriate balance between risk and return, of the numeraire currency and of the degree of public disclosure, from which some conclusions are drawn concerning the future of the US dollar as a reserve currency and volatility in financial markets. The discussion relies extensively on a survey of central banks and monetary authorities representing in total about 80% of global foreign exchange reserves at end-2006.



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# FX reserve management: trends and challenges

Claudio Borio, Gabriele Galati and Alexandra Heath

## 1. Introduction<sup>1</sup>

In recent years, the growth in official foreign exchange reserves has led to renewed interest in the way reserve management decisions are taken and in their possible impact on financial markets. Indeed, reserve management practices have evolved substantially over the past decade or so. While certain aspects of this evolution have received considerable attention, others, which are less apparent but arguably as important, have been less remarked upon.

Against this backdrop, the objective of this paper is threefold: to provide an overview of the evolution and current state of reserve management practices<sup>2</sup> in the central banking community; to seek to identify the main factors behind this evolution; and, based on this analysis, to highlight a number of challenges ahead and to speculate on the implications of the way they might be resolved for market functioning.<sup>3</sup> This paper relies extensively on an ad hoc survey carried out among 28 central banks accounting for some 80% of world reserves at end-2006, which served as background for a meeting on reserve management held at the BIS in early 2007. The material was revised and updated in mid-2007.<sup>4</sup>

We highlight several trends and reach a number of conclusions. First, there has been a tendency for reserve management processes to converge to those in place in the private asset management industry. In particular, an increased focus on returns relative to liquidity and safety (capital preservation) has gone hand-in-hand with a major strengthening of internal decision-making processes, designed to improve the internal governance of reserve

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<sup>1</sup> This paper elaborates on several arguments initially put forward in BIS (2007a). The paper was the basis for the closing lecture at the 3rd CEPR Conference of Past, Present and Policy entitled “Foreign exchange reserves and the international monetary system: Genoa and beyond” held in Genoa, Italy on 27–28 March 2008. We would like to thank David Archer, Piti Disyatat, Jannecke Ebbesen, Már Gudmundsson, Alex Joia, Jens Ulrich and participants at a meeting on “Challenges in FX reserve management” held at the BIS on 1–2 March 2007 for comments that have contributed greatly to the final paper. We would also like to thank Clara Garcia for tireless, excellent research assistance. The views expressed in this paper are those of the authors, and do not necessarily represent those of the Bank for International Settlements.

<sup>2</sup> For current purposes, foreign exchange reserve management is defined narrowly as the allocation of foreign exchange reserves across asset classes and instruments, and does not include decisions concerning the *level* of reserves or foreign exchange intervention; on these aspects, see, for instance, BIS (2005a), de Beaufort Wijnholds and Kapteyn (2001), Galati et al (2005), IMF (2001), Neely (2005, 2007) and Roger (1993). The analysis also focuses only on the foreign currency portfolio managed by central banks and monetary authorities, which generally corresponds closely to the aggregate foreign exchange reserves included in the IMF’s Special Data Dissemination Standard (SDDS). Based on the notion that a key function of foreign exchange reserves is to meet liquidity needs in some form or other, this standard draws a demarcation line between official foreign exchange reserves and other public sector foreign exchange claims and liabilities. As a result, the analysis does not cover other stabilisation/legacy/investment funds that may be present in the country, even when they are managed by the central bank, such as the Government Pension Fund (formerly the Petroleum Fund) in Norway (IMF (2007), Truman and Wong (2006)).

<sup>3</sup> This paper is best read in conjunction with Borio et al (2008), which provides a broad conceptual framework for foreign exchange reserve management practices and a roadmap for the corresponding decisions.

<sup>4</sup> Responses were recorded for 28 central banks and monetary authorities, including 10 from industrialised countries and eight from Asia.

management, and with a greater degree of disclosure, a key aspect of external governance.<sup>5</sup> Second, these trends have reflected changes in the economic and institutional environment, several of which are similar to those influencing other aspects of central banking. We highlight, in addition to the large accumulation of foreign exchange reserves, the development of financial know-how and markets, and the trend towards strengthening the accountability of central banks. Third, while the trends in reserve management are common to all central banks, practices still differ considerably, reflecting country-specific circumstances. Fourth, defining the acceptable risk-return trade-off for the institution and the related question of the choice of numeraire remain key challenges; and the way they are resolved could have significant implications for market functioning. Likewise, the appropriate degree of disclosure remains a highly contentious issue.

The rest of the paper is organised as follows. Section 2 documents the main changes in reserve management practices. Section 3 highlights the principal drivers of these trends. Section 4 discusses some of the main challenges ahead and the potential impact of their resolution on market functioning. In the concluding section we summarise the key points of the analysis.

## **2. Trends**

When considering the evolution of reserve management practices over the past decade, at least four interrelated general trends deserve particular attention: an increased focus on returns; the adoption of a more structured approach to decision-making, underpinned by a strengthening of internal governance; a stronger focus on risk management; and a greater degree of public disclosure. Similarly to what has happened for monetary and supervisory policy, these trends pertain to the objectives, instruments and accountability of central banks. Despite these common trends, there is still considerable variation in central banks' practices.

### **2.1 An increased focus on returns**

While all central banks naturally place some weight on the return objective when making their reserve management decisions, the survey revealed that safety (capital preservation) and liquidity are still universally agreed to be the primary goals. At the same time, however, the weight on the return objective has generally increased over time. This has concretely manifested itself in at least five ways.

First, central banks have broadened the range of asset classes in which they can invest and have shifted the portfolio composition towards higher risk allocations. Traditionally, foreign exchange reserves were held in highly liquid, safe assets, such as bank deposits, Treasury bills, and (highly rated) government and supranational bonds. While these asset classes are still the main ones in reserve portfolios (Table 1), over time, central banks have also tended to increase their appetite for market, credit and, to a lesser extent, market liquidity risks.

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<sup>5</sup> The increased focus on returns and greater disclosure are the aspects that have attracted most attention; see, for instance, Bernadell et al (2004), Pringle and Carver (2006) and Truman and Wong (2006). The changes in governance have been explored in less depth; for exceptions, see, notably, Bakker (2007), who focuses primarily on external governance.

Table 1  
**Investable asset classes and instruments**  
Percentage of responding central banks

Asset class or instrument	2002	2004	2005	2007 <sup>1</sup>	2007 <sup>2</sup>
Supranational bonds	*	86	*	96	*
Treasury bills	*	89	*	100	*
Bank deposits	*	94	*	96	*
Government bonds	*	80	*	100	*
Government bonds below AA	*	57	57	33	*
Agency paper	81	65	67	93	88
Mortgage-backed securities	} 37	28	25	59	} 42
Asset-backed securities		29	25	48	
Corporate bonds (investment grade)	} 23	17	21	41	35
Corporate bonds below BBB		2	4	7	2
Index-linked bonds	*	*	25	56	37
Equities	12	6	8	19	9
Hedge funds	2	2	0	4	2
Other	93	15	8	52	12 <sup>3</sup>
Derivatives	52	*	*	89	80
Gold	*	57	*	81	*
<i>Memo: number of respondents</i>	43	65	48	27	43

\* Indicates that this option was not available.

<sup>1</sup> Responses to a survey completed for the BIS meeting on “Challenges in FX reserve management” held on 1–2 March 2007 and revised and updated in mid-2007. Responses were recorded from 28 central banks and monetary authorities, including 10 from industrialised economies and eight from Asia, representing in total about 80% of global foreign exchange reserves at end-2006. <sup>2</sup> JPMorgan. <sup>3</sup> Emerging market bonds.

Sources: BIS survey; JPMorgan; Pringle and Carver (2003, 2005, 2006).

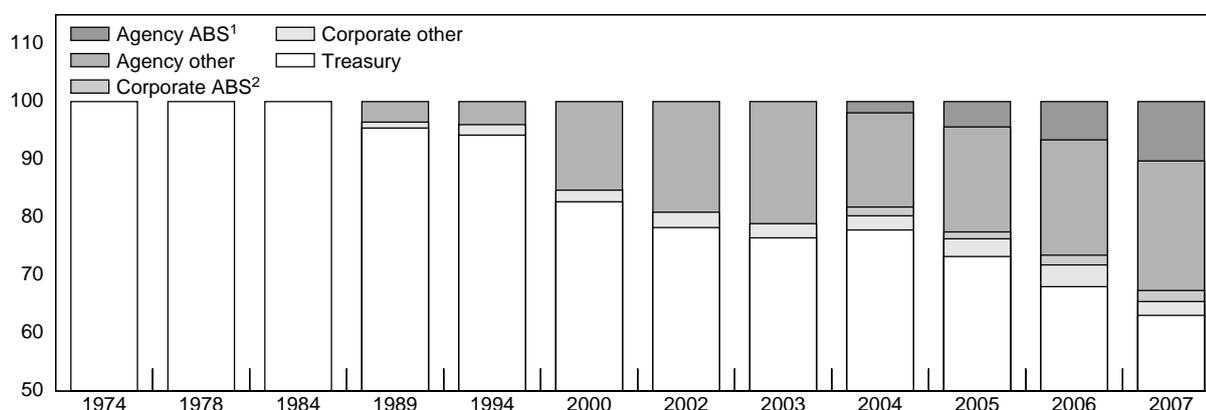
As far back as in the late 1980s and early 1990s, central banks started increasing their investments in longer-duration assets, most notably agency paper (Graph 1). Since the late 1990s, their revealed preference for forms of asset-backed securities, especially mortgage-backed securities, has also increased: some, although still relatively few, also invest in (investment grade) corporate debt and even equities.<sup>6</sup> This trend is likely to continue in the near future: several central banks have recently announced that they are considering whether to include corporate debt and equities in their eligible asset classes.<sup>7</sup>

<sup>6</sup> For the experience of the Swiss National Bank, which has recently included both equities and corporate bonds in its reserve portfolio, see Hildebrand (2004).

<sup>7</sup> The Bank of Korea, for example, recently discussed the possibility of investing in equities; see “Bank of Korea weighs overseas investments”, *Financial Times*, 9 February 2007. Admittedly, these plans were announced before the financial market turmoil that erupted in the second half of 2007 (Borio (2008)). Surveys carried out since then suggest that some central banks have naturally become more cautious, while others have not

Graph 1

**Foreign official holdings of US long-term securities**  
As a percentage of total foreign official holdings



<sup>1</sup> Backed primarily by home mortgages. <sup>2</sup> Backed by a wide variety of assets, such as car loans, credit card receivables, home and commercial mortgages, and student loans.

Source: US Department of Treasury.

The fact that, on balance, central banks have been gradually reducing their investments in gold is also broadly consistent with this trend (Graph 2). True, gold holdings reflect a number of considerations, including historical factors. Moreover, in general, the management of gold reserves is not closely integrated with that of the rest of the portfolio. Thus, trends in the range of investable assets have not typically influenced decisions on gold reserves. Partly reflecting this confluence of factors, gold holdings remain quite common, although the amounts involved vary widely across central banks.<sup>8</sup> Even so, in some countries central banks have come under pressure to sell those holdings because of inadequate returns compared with other asset classes. Moreover, at least until recently, greater awareness of the implications of standard risk-return analysis has in some cases added to the justification for shifting away from this asset class.<sup>9</sup>

Second, central banks have increasingly been making use of derivatives. The extent to which derivatives are used varies across central banks: while some use close to the full range of currency and interest rate derivatives, a non-trivial number of central banks employ a very limited range or exclude them altogether. Forwards and currency swaps are used by most central banks, while futures and interest rate swaps are less common and options are relatively rare. Nevertheless, the trend is indicative of a greater willingness to gain additional room for manoeuvre in the management of reserves, pushing out the risk-return frontier. This is because derivatives permit the decoupling of positions held in the underlying (cash) securities from the exposures to asset classes per se, be this for longer-term (strategic) positions or for the more active (tactical) position-taking (so-called “overlay strategies”).

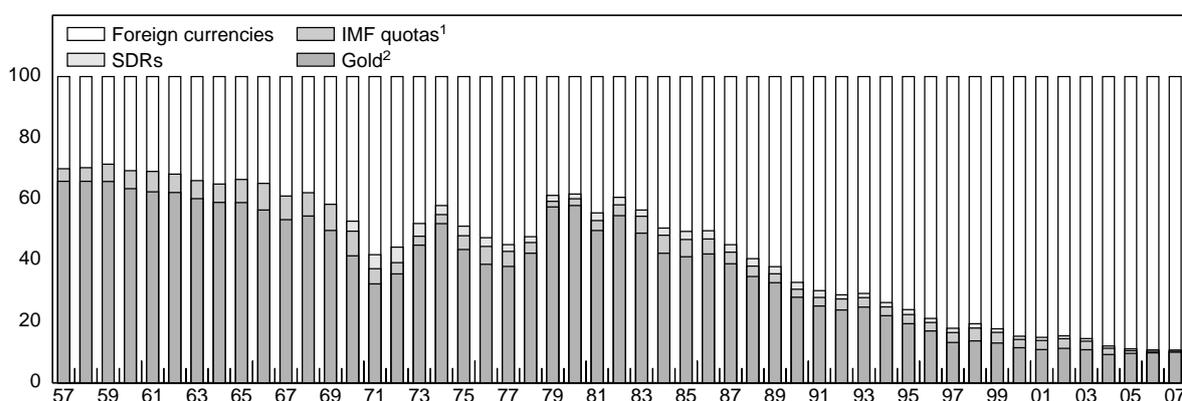
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allowed developments to change their strategic, as opposed to tactical, decisions (Pringle and Carver (2008)). In any case, as argued further below, the structural forces encouraging an increased focus on returns remain in place, and this focus can be pursued without investing in the asset classes most directly affected by the turmoil, such as structured credit products.

<sup>8</sup> In several central banks, not least from emerging market countries, gold holdings are effectively non-existent or very small compared with the size of the reserves.

<sup>9</sup> See, for instance, Hildebrand (2005) for a discussion of the Swiss experience.

**Graph 2**  
**Composition of official reserve assets**  
As a percentage of total reserves



<sup>1</sup> Reserve tranche and creditor positions of IMF members. <sup>2</sup> At market prices.

Source: IMF.

Third, in a development closely linked with the broadening of the investable universe, central banks have been making increased use of external managers. Responses to the BIS survey indicated that over two thirds of central banks employed external managers, although the range of utilisation varied considerably. In most cases, only a small fraction of reserves (not more than 5%) was managed externally. A few central banks, however, outsourced a significant share (greater than 15%). The most frequently cited motivations for using external managers included developing expertise and gaining access to asset classes for which in-house know-how was lacking, such as mortgage-backed securities (Table 2).

Table 2

**Use of external managers**

Percentage of responding central banks using external managers

Reasons for using external managers	%	Asset classes covered	%
Knowledge transfer	59	Government bonds	58
Specific expertise	56	Mortgage-backed securities	54
Returns/diversification	41	Currency	42
Internal benchmarking	37	Corporate bonds	35

Source: BIS survey.

Fourth, there has been a growing tendency to separate the reserve portfolio into tranches with different objectives. Around two thirds of the central banks responding to the BIS survey had established two (or more) separate tranches. These are generally referred to as the liquidity and investment tranches. Each tranche has separate investment guidelines. In particular, in the investment tranche reserves can be managed with a greater focus on return without compromising the primary objectives of safety and liquidity embodied in the liquidity tranche. The specific criteria for defining each tranche differ somewhat across central banks, and consequently there are significant differences in their relative and absolute sizes. In some cases, less than 10% of reserves are allocated to the liquidity tranche, while in others, well over half of reserves are still held in this tranche.

Table 3  
**Sovereign wealth funds**

Country	Fund name	Assets managed <sup>1</sup>	Inception year	Source of funds
United Arab Emirates	Abu Dhabi Investment Authority	875	1976	Commodity wealth
Norway	Government Pension Fund – Global	380	1990	Commodity wealth
Singapore	Government Investment Corporation	330	1981	Other, including foreign exchange
Kuwait	Kuwait Investment Authority	250	1953	Commodity wealth
China	State Investment Corporation	200	2007	Foreign exchange
Hong Kong SAR	HKMA Investment Portfolio	163	1998	Foreign exchange
Singapore	Temasek Holdings	159	1974	Other
Russia	Oil Stabilisation Fund	125	2004	Commodity wealth
Australia	Australian Future Fund	61	2006	Other
Qatar	Qatar Investment Authority	60	2000	Commodity wealth
Libya	Libyan Arab Foreign Investment Company	50	1981	Commodity wealth
Algeria	Revenue Regulation Fund	43	2000	Commodity wealth
Alaska, USA	Permanent Reserve Fund	40	1976	Commodity wealth
Russia	National Welfare Fund	32	2008	Commodity wealth
Brunei	Brunei Investment Agency	30	1983	Commodity wealth
Korea	Korea Investment Corporation	30	2005	Foreign exchange
Total		~3,200		

<sup>1</sup> In billions of US dollars; estimates from the Sovereign Wealth Fund Institute as at 19 March 2008.

Sources: Sovereign Wealth Fund Institute; national data.

Finally, there have been a number of cases where foreign exchange reserves have been used to create a separate fund from the central bank's balance sheet with a stronger mandate to focus on returns – now known, sometimes misleadingly, as Sovereign Wealth Funds (SWFs).<sup>10</sup> Recent examples include the State Foreign Exchange Investment Corporation (China), which was announced in March 2007 and started operations towards the end of 2007, and the Korea Investment Corporation, which was launched in 2005 (Table 3). In addition, high levels of commodity prices, particularly for oil, have led to substantial growth in a number of other SWFs that were created to stabilise the impact of commodity price fluctuations on the fiscal balance or to preserve the value of commodity

<sup>10</sup> The term is misleading whenever SWFs are set up by the transfer of foreign exchange reserves which are financed through foreign or domestic currency borrowing (in the case of sterilisation proceeds), and therefore do not actually represent net wealth; see eg Rhee (2007) and Rozanov (2008).

wealth for future generations. Overall, the funds managed by SWFs are estimated to be around \$3.2 trillion.<sup>11</sup>

## 2.2 A more structured approach to decision-making

Over the past decade, there has been a major trend towards a more structured approach to reserve management decisions. This trend has both supported and encouraged the increased focus on returns. The trend has two dimensions. First, there has been a move towards a more top-down approach to decision-making, with more formal involvement of the executive at the strategic level, accompanied by a distinct vertical tiering of the process. Second, there has been a tendency to increase the functional separation of the activities involved in the reserve management process (“horizontal separation”).<sup>12</sup>

The trend towards a more top-down approach is arguably the most important internal development in reserve management over the last decade or so. In general, central banks now see strategic decisions about the foreign exchange reserve portfolio as part of a broader decision about the acceptable risk-return trade-off for the institution as a whole. As a consequence, within any limits set in the statutes or legislation, the definition of the investable universe, the broad investment guidelines and the target allocations of the portfolio have formally tended to become the responsibility of the executive level. This Strategic Asset Allocation (SAA) is articulated by selecting a benchmark portfolio and by defining the tolerance ranges within which the actual allocation is allowed to vary (Table 4). These decisions are usually based on advice provided by risk analysts and other specialists involved in the reserve management process. The trend represents a major shift in practices from a world in which the portfolio was more commonly constructed bottom-up and in which the role of “drift” in asset allocations was greater.

The executive, therefore, ultimately determines the management “style” of the institution. Should the executive decide that the institution has very little tolerance for risk, it is likely that the investable universe will be defined relatively narrowly, and that the job of the portfolio managers will be to replicate the benchmark portfolio in the most cost-effective way. In this case, most of the decisions are summarised in the strategic benchmark. This, for example, is the case of the Reserve Bank of Australia. Should the executive decide that the institution has more risk tolerance, the investable universe would be defined more broadly and the portfolio managers could be given greater freedom to take on risk within specified guidelines.

In addition, a growing number of central banks have been putting in place an intermediate layer between the SAA level and the portfolio management execution level, at which decisions aimed at exploiting shorter-term market developments are taken – a Tactical Asset Allocation (TAA) level. By mid-2007, almost half of the central banks participating in the BIS survey had introduced such a layer, and others were considering such a move (Table 4). The reason for putting in place this layer is twofold, viz. to centralise and discipline position-taking and to exploit the expertise of a layer of management regarded as best suited for this task.<sup>13</sup>

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<sup>11</sup> Moreover, in general, the shift away from sole management by the central bank need not imply a more conservative management style for the reserves retained by the central bank relative to the past. In Norway, for instance, the experience gained through the management of the special fund has allowed the central bank to be less conservative with the management of the reserves on its own balance sheet. Such complementarities may in fact turn out to be quite common.

<sup>12</sup> For a general discussion of possible organisational set-ups and implementation issues, see, for instance, Borio et al (2008) and Cardon and Coche (2004).

<sup>13</sup> This can be thought of as akin to the “constrained discretion” that inflation targeting regimes have been expected to provide.

In some central banks, members of the executive are involved in TAA decisions, while in others, a non-executive committee has primary responsibility.

Table 4  
**SAA design and implementation**  
Percentage of responding central banks

	With TAA (46%)	No TAA (54%)
SAA includes fully specified benchmark for		
Across currencies	100	86
Of which currency overlay	67	42
Across asset classes	100	77
Within fixed income	92	71
Benchmark indices		
Internal	50	57
Customised commercial	58	50
Standard commercial	33	29
Portfolio managers mandated to use		
Indexing	67	57
Enhanced indexing	33	50
Active management	100	92
By currency	58	77
By risk	67	62
Mark-to-market management	100	100
Accounting standards		
Full mark-to-market	31	69
Historical/asymmetric	58	42

Source: BIS survey.

The experience at one central bank epitomises the reasons for the shift in this direction. At this central bank, when no TAA layer was present, decisions at the strategic level were resulting in frequent shifts in the SAA. This indicated that the SAA had, in fact, very much the character of portfolio-wide position-taking aimed at taking advantage of short-term market movements. The introduction of the TAA reflected dissatisfaction with this approach.

The trend towards a greater horizontal separation of activities in the reserve management process has also been quite marked. The objective has been to strengthen the integrity of the process, not least by limiting opportunities for actual or perceived conflicts of interest. Separation takes two forms. One is functional, whereby specialised functions are placed in different organisational units. A second concerns reporting lines, thereby ensuring that different functional units do not report directly to the same managers.

In general, asset management and settlement functions are almost always separated from middle office functions, such as performance measurement, risk analysis and compliance with investment guidelines. The degree to which these “middle office” functions have been

separated still varies considerably across central banks. In some cases all these functions are grouped in the same functional unit, while in others several functional areas cover these activities. As regards reporting, the line managers of these areas report to the same person in some central banks, suggesting relatively little reporting separation (Table 5). However, there is an increasingly apparent trend to have reporting lines that remain separate up to the executive level. This has been especially the case at central banks that have recently conducted a significant overhaul of their operations.<sup>14</sup>

Table 5  
**Separation of reporting lines**  
 Percentage of responding central banks

	Front and back office	Front and middle office <sup>1</sup>
Separated until executive level	48	28
Separated until an intermediate level	28	36
Separated to head of department level or lower	24	36

<sup>1</sup> Middle office is defined here to be the functional area responsible for performance evaluation and attribution.

Source: BIS survey.

## 2.3 Strengthened risk management

A natural complement to an increased focus on returns and a more structured decision-making process has been a strengthening of risk management practices. This has affected both financial risks and operational risks.

### 2.3.1 Financial risks

Risk management has evolved most for market and credit risks. The overall goal of keeping reserves in instruments that are liquid means that the need to develop more sophisticated ways of addressing liquidity risk has not been that pressing. Liquidity risks are generally incorporated in the SAA by ensuring that the instruments in the investable universe can be easily traded in the market, based on indicators such as the size (capitalisation) of the

<sup>14</sup> The treatment of operational risk functions is an interesting example of how internal organisation has changed as the decision-making process has become more structured and top-down. This change has taken three forms. First, as operational risk has been perceived as an area of key and increasing importance, the executive level has become increasingly involved in its strategic management. Second, by mid-2007 well over half of the central banks responding to the BIS survey had put in place an institution-wide strategy for dealing with operational risk. Third, around half of those central banks had already established a separate functional unit to develop and implement the bank-wide operational risk strategy, while several more had plans to do so in the near future. Often this operational risk unit reported directly to the executive level. Otherwise, the reporting lines reflected the central bank's view on which operational risks were most important: in some, the unit was associated with the IT department and in others with the department in charge of bank security. In most of the remaining central banks, the strategic decisions about operational risk were made by functional areas with existing responsibilities for risk management.

market, bid-ask spreads and the volume of activity, and/or whether well developed repo markets for them exist.<sup>15</sup>

Market risk accounts for the largest share by far of the financial risk to which foreign exchange reserves are exposed. Much of this risk is unavoidable, takes the form of exchange rate risk and is associated with the net foreign exchange position. This reflects a policy decision that reserve managers take as given.<sup>16</sup> Within this constraint, however, there is ample room for manoeuvre.

Attention to market risks has grown at two levels. First, in the design of the portfolio, in particular the SAA, more rigorous analysis of market risks over the relevant horizons has become an increasingly important element of reserve management practices. Subject to the inevitable estimation/calibration problems, the role of quantitative analysis has risen. Second, in the implementation of the portfolio, there has been a tendency to track more closely actual exposures relative to the desired targets and to permissible tolerance ranges.

Over time, the technology for measuring market risk has been refined significantly. As part of the basic design of the portfolio and/or of a check on its robustness, a majority of central banks in the survey used stress tests/scenario analysis (Table 6). While tolerance ranges for fixed income securities were generally set in terms of duration, a few central banks had shifted to more sophisticated variants of tracking error or value-at-risk (VaR) methodologies. To monitor risks, almost all central banks responding to the BIS survey used VaR to measure the risk in the reserve portfolio. Variants of duration/sensitivity analysis were mainly used as a way of addressing potential model and miscalibration risk. In addition, roughly one half of the responding institutions relied on back testing to manage this type of risk.

Table 6  
Market risk

Percentage of responding central banks

Scope and methodology	
Aggregated over the total portfolio	52
Measurement methods	
Value-at-risk	96
Duration analysis	89
Stress testing	71
Other	43
Back testing	50
Of which over the total portfolio	82

Source: BIS survey.

<sup>15</sup> In addition, specific constraints may be present, including minimum issue sizes and concentration limits on issues. An exception to this general pattern is the United Kingdom, where the formal quantitative exercise underpinning the asset allocation is based on liquidity considerations.

<sup>16</sup> If foreign exchange reserves serve a pure ex ante liquidity function, they need not imply a long (positive) net foreign exchange position. Reserves may be borrowed in foreign currency, as, for example, in the cases of New Zealand and Canada; see eg Borio et al (2008).

Central banks are highly sensitive to the credit risk incurred in their portfolios, well beyond the pure financial loss that may result from it. In fact, their credit risk tolerance is low primarily because of the reputational costs perceived to be associated with a credit event. It is only natural that, as the institutions have cautiously moved down the credit spectrum in asset allocations, credit risk management systems have been strengthened.

Credit ratings are central to the management of credit risk (Table 7). Minimum ratings, for instance, are used to define risk tolerance by restricting the set of investable assets and the range of counterparties. Often, for counterparties this information is combined with balance sheet analysis, such as capitalisation and standing in the business. Credit risk exposure limits based on minimum ratings may differ across categories of counterparties, such as banks and non-banks, and across asset classes, for example bonds held for investment purposes and the counterparties in OTC transactions.

Table 7

**Credit risk**

Percentage of responding central banks

Credit limits based on	
Credit rating	96
Balance sheet information	74
Type of counterparty	44
Size of foreign exchange reserves	44
Maturity	44
Other	19
Scope of credit limits	
Investments	92
Deposits	85
Derivatives	85
Reverse transactions	69
Settlement	58
Concentration limits	
By sector	63
By country	58

Source: BIS survey.

Many central banks complement credit limits on individual obligors with concentration limits, which are designed to maintain sufficient diversification. Several central banks have concentration limits that apply to particular sectors, such as banking; country limits are not uncommon.

In addition, some central banks have separate obligor limits for exposures to counterparties in connection with currency deposits, gold deposits, collateralised operations and settlements, and for different categories of exposure (eg settlement). In addition to setting limits on exposures, collateral can also be used to mitigate credit risk (specifically, the loss given default). In general, central banks accept government securities (possibly including agency paper) as collateral and, sometimes, also paper issues by supranationals. In some

cases, there are additional restrictions. These commonly relate to residual maturity (eg not exceeding 10 years) or may target more specific liquidity concerns (eg minimum size of the issue outstanding and maximum percentage of the issue held in the portfolio). Haircut practices are also very similar, with central banks generally following accepted market standards.

### **2.3.2 Operational risk**

While operational risk has always been managed to some extent, there has been a clear trend towards a more structured and comprehensive treatment, analogous to the way in which financial risks are managed. Given the tight link between operational risk and reputational risk, most central banks include reputational risk as a part of the responsibilities associated with operational risk activities.

The increased focus on strengthening operational risk management is reflected in several developments. As noted above, at a strategic level, many central banks have separated business areas and reorganised reporting lines to address conflicts of interest. In addition, most central banks have detailed business continuity plans that are regularly reviewed. A significant minority of central banks responding to the BIS survey have remote disaster recovery sites that provide comprehensive back-up facilities and full access to trading, settlement and payments systems. Others have secondary trading facilities, often through existing representative offices.

At the level of day-to-day operations, many central banks have improved staff training and the extent to which there are formal, written policies and procedures, as a means of fostering a culture of sound management.<sup>17</sup> Many have also invested considerable resources to increase the degree of automation in their operations as a means of mitigating risk from human error. Around half of the central banks responding to the BIS survey reported straight-through-processing rates of over 90%. However, automation levels are still very low in some central banks, although in most of these cases there are projects underway to remedy this.<sup>18</sup>

A significant problem for measuring operational risk is that, compared with financial risk, there is a dearth of data available for estimating loss distributions. Indeed, quantifying and evaluating operational risk is one of the biggest challenges central banks face in this area (Table 8). The survey indicated that in roughly half of the responding central banks self-assessment of the probability and size of an operational risk “event” was used to help identify key areas of vulnerability and to define a priority list of areas for improvement (risk mapping).<sup>19</sup> A majority of central banks kept an event log or maintained incident reports. This is regarded as a more objective way of assessing both the frequency and severity of operational risk events. As events are recorded, new vulnerabilities may be identified and the priorities for attention may be reordered. Once sufficient data from event logs are gathered, it is possible to use this information as an input in the construction of key risk indicators, which are designed to identify operational risk vulnerabilities before they become problematic. Relatively few central banks reported using key risk indicators, and those that did always did so in conjunction with other identification methods.

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<sup>17</sup> This is also an important aspect of mitigating legal risk, which has become more of a focus given the trend towards expanding the set of investable assets, particularly derivatives.

<sup>18</sup> The Basel Committee notes that increased automation could change the nature of operational risk by transforming high-frequency, low-severity losses into low-frequency, high-severity losses.

<sup>19</sup> Factors that might be used to assess the operational risk in a reserve management area are the size and complexity of the portfolio, the degree of independence given to individual portfolio managers, the concentration of knowledge, experience and skills in specific individuals and the degree of manual entry used.

Table 8

**Measuring operational risk**

Percentage of responding central banks

<b>Methodology</b>	
Event log	67
Self-assessment based on questionnaires	59
Key risk indicators	37
Other	56

Source: BIS survey.

**2.4 Increased public disclosure**

Over time, central banks have increased public disclosures about reserve management practices, including information on the broad frameworks in place, the composition of benchmarks, and performance.

Despite the trend towards greater disclosure, central banks still vary considerably in terms of the type of information provided, its frequency and reporting lag. Based on available public information for a sample of banks, most of them supply information about their institutional structure, and a significant majority of these institutions also report on their risk tolerance via the same sources, mostly annual reports and websites (Table 9). A significant majority also release information about the asset classes eligible for investment in the strategic benchmark. Relatively few institutions, however, provide information about the currency allocation in the benchmark; notable exceptions include, among others, the Reserve Bank of Australia, the Bank of Canada, the European Central Bank, the Bank of England and the Central Bank of the Russian Federation, which provide full information on the currency composition of the benchmark. Almost half of the central banks in the above sample disclose information about performance.

Table 9  
External disclosure<sup>1</sup>

	Institutional framework	Investable universe	Asset allocation <sup>2</sup>	Currency allocation <sup>3</sup>	Performance	Reserves outstanding (Dec 2007) <sup>4</sup>
China	√					1,528.3
Japan	√	√			√	948.4
Russia	√	√	√	√	√	464.0
Taiwan, China						270.3
India	√	√			√	266.6
Korea	√	√				261.8
Euro area	√	√		√		203.2
Brazil	√	√				179.4
Singapore	√	√				162.5
Hong Kong SAR	√	√	√		√	152.7
Algeria						110.2
Malaysia						100.6
Mexico	√					86.3
Thailand	√					85.1
Turkey	√	√ <sup>5</sup>				73.4
Indonesia		√ <sup>5</sup>				54.7
United Kingdom	√	√	√	√	√	49.0
United States	√	√	√	√		45.8
Switzerland	√	√	√	√	√	44.5
Argentina	√	√	√	√	√	44.2
Canada	√	√	√	√	√	41.0
Saudi Arabia	√					32.3
South Africa	√	√				29.6
Australia	√	√	√	√	√	24.8

<sup>1</sup> In contrast to the information in the other tables, the data here are not derived from the BIS survey, but from disclosures made via official publications, such as annual reports, or the internet. The sample of countries here includes countries in the G20, and/or with reserves exceeding \$80 billion at the end of December 2007 and does not correspond to that of the BIS survey. The symbol √ indicates “yes” and a blank cell indicates “no”.

<sup>2</sup> Specific information on shares of different asset classes. <sup>3</sup> Specific information on shares of different currencies. <sup>4</sup> Official foreign exchange reserves in billions of US dollars. <sup>5</sup> Limited.

Sources: IMF; websites and annual reports of central banks and monetary authorities and authors' assessment of that information.

### **3. The main factors behind the trends**

The trends in central bank foreign exchange reserve management identified above have been underpinned by several key developments in the economic and institutional environment. The most important among these are: the large accumulation of reserves by some countries; advances in financial technology and the development of financial markets; and changes in the external governance environment within which central banks operate.

#### **3.1 Reserve accumulation**

Following the Asian crisis, there was a pick-up in the accumulation of foreign exchange reserves, which has accelerated in recent years and has been concentrated in a relatively small number of economies (BIS (2007a)). Official reserves held by monetary authorities more than tripled over the period 2001–2007, to reach some \$6.3 trillion at the end of 2007. In the wake of the Asian crisis, the build-up reflected mainly the wish to create a war chest to self-insure against the risk of another shock, whereas in more recent years it appears to have resulted primarily from intervention in foreign exchange markets in response to upward pressure on exchange rates. Other factors, such as high commodity prices and valuation effects arising from significant exchange rate movements and income flows, are also likely to have boosted reserves measured in US dollars.

While measuring the “adequacy” of reserves with any precision is quite hard, in some countries the stock of reserves does appear to be well above standard measures of adequacy based on liquidity considerations alone (Table 10). This is most apparent where the main factor driving reserve accumulation has ceased to be a conscious effort to build up a war chest, but has rather become the by-product of attempts to lean against the appreciation of the domestic currency.

To varying degrees, this substantial accumulation of “excess” reserves has tended to support all the trends noted above. It has naturally shifted the balance of objectives towards more return-oriented strategies, not least owing to pressure from the body politic to earn an adequate return on an increasingly large fraction of a country’s resources.<sup>20</sup> From this perspective, the stronger calls for transparency and disclosure could be regarded as part and parcel of the same process. In turn, the shift towards more return-oriented strategies has put a premium on strengthening internal decision-making.

#### **3.2 The development of financial know-how and markets**

There are at least two ways in which advances in financial technology and the development of financial markets have played a supporting or enabling role in the trends observed in reserve management practices.

For one, much as in the private sector, advances in financial know-how have provided central banks with the tools necessary for a more sophisticated analysis of risk-return trade-offs and for the management of different risks. This development has enabled the transition

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<sup>20</sup> Another possible conjunctural factor encouraging a greater return orientation may have been the low interest rate environment, which has no doubt played a significant role in the private sector (BIS (2004)). This could at least be the case where reserves are managed on a stand-alone basis, regardless of the liabilities that finance them. The quantitative relevance of this influence in reserve management, however, is unclear. Similarly, if the proximate cost of financing is taken into account, a positive cost of carry (a higher rate on domestic currency liabilities relative to the rate earned on reserves), may have played a similar role. As McCauley (2007) points out, however, for several large foreign exchange reserve holders that cost has been negative. For a further discussion, see below.

towards a more structured decision-making process. In fact, central banks have followed a much broader trend in the asset management sector of the financial industry, borrowing and putting in place very much the same kind of processes and tools.

Table 10  
Foreign exchange reserves and measures of adequacy

	Outstanding position, USD bn		Reserves/ imports <sup>1</sup>		Reserves/ broad money <sup>2</sup>		Reserves/ short-term debt <sup>3</sup>	
	2000	2007	2000	2007	2000	2007	2000	2007
China	166	1,528	9	19	10	28	8	14
Japan	347	948	11	18	6	15	2	2
Taiwan, China	107	270	9	16	19	34	8	7
Russia	24	464	6	23	44	78	2	5
Korea	96	262	7	9	29	43	2	2
Other Asia <sup>4</sup>	325	852	6	8	27	32	2	2
Latin America <sup>5</sup>	136	397	5	8	23	32	1	3
Middle East <sup>6</sup>	75	271	9	11	25	38	2	3
Central and eastern Europe <sup>7</sup>	66	223	5	4	39	34	2	1
Industrial economies <sup>8</sup>	344	380	1	1	3	2	0	0

<sup>1</sup> Months of imports. <sup>2</sup> In per cent. <sup>3</sup> Ratio; short-term external debt defined as short-term liabilities to BIS reporting banks: consolidated cross-border claims of all BIS reporting banks on countries outside the reporting area with a maturity up to and including one year plus international debt securities outstanding with a maturity up to one year; based on outstanding year-end positions. In the case of Saudi Arabia, the latter are not included; for Libya and Saudi Arabia, includes only international securities. <sup>4</sup> Hong Kong SAR, India, Indonesia, Malaysia, the Philippines, Singapore and Thailand. <sup>5</sup> Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. <sup>6</sup> Egypt, Jordan, Kuwait, Lebanon, Libya, Oman, Qatar, Saudi Arabia and United Arab Emirates. <sup>7</sup> Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. <sup>8</sup> Canada, the euro area, Switzerland, the United Kingdom and the United States.

Sources: IMF; Datastream; BIS.

In addition, the development of financial markets has supported the shift towards a more return-oriented strategy. It has done so by increasing the range of assets that provide an acceptable level of liquidity while offering attractive yields, such as some varieties of mortgage-backed securities, and by raising the capacity of central banks to obtain funds at short notice by posting collateral, such as through repos. In addition, as already noted, the use of derivatives has strengthened this trend, by providing greater flexibility in asset management strategies. Prospectively, derivatives markets could also support a further broadening of the investable universe. For example, the emergence of deep markets for credit default swaps could allow central banks to manage the risks associated with entry into corporate bond markets more effectively, at least if their liquidity proves robust to severe market stress.

### 3.3 Changes in the external governance environment

Crucially, and this is probably underestimated, the impact of changes in the external governance environment has been far-reaching and multifaceted, helping to explain the international breadth of the observed trends. After all, these trends are by no means limited to those institutions which have been accumulating reserves. They are, in fact, much broader and have often gone furthest elsewhere, especially with respect to the strengthening of internal decision-making.

The global shift towards greater central bank independence has increased the emphasis on accountability and transparency (Eijffinger and Geraats (2006)). This has been one of the factors motivating a greater degree of external disclosure in reserve management and a strengthening of internal governance processes. In some countries, it has also added pressure to obtain higher returns on reserves.

At the same time, there has been more focus on the importance of reputation and credibility for effective policymaking. This has heightened the sensitivity of central banks to the need for sound investment processes, in terms of both the effectiveness and security of operations and the management of potential conflicts of interest. The role of many central banks as regulators and standard setters for the private sector, and hence their need to lead by example, has simply added to such incentives.

As a part of this trend, on balance, central banks have also become more favourably disposed to the view that greater disclosure on reserve management practices can help in the performance of their primary responsibilities. For example, in the foreign exchange reserves area, following the Asian crisis the international community agreed on a strengthened disclosure standard, encapsulated in the SDDS. Admittedly, this standard relates only to the *level* of reserves and some aspects of their composition. It is silent about most of the main aspects of reserve management, notably their allocation across currencies and asset classes. As a result, disclosure practices are left to the discretion of national authorities, reflecting a mixture of economic, institutional and political factors.<sup>21</sup> Even so, the general shift in basic philosophy has probably had an influence on disclosures concerning reserve management practices as well.<sup>22</sup>

## 4. Challenges

The above trends in reserve management have inevitably raised significant challenges for central banks. While some of these challenges have implications that are largely confined to the internal organisation and running of the institution, others can have more significant implications for financial markets and exchange rates. In what follows, we largely focus on the latter. We consider, sequentially, the decisions required concerning the appropriate risk-return balance for the institution, the choice of the numeraire for the measurement of returns and risks, and the extent of public disclosure.

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<sup>21</sup> The IMF has also produced a set of guidelines for foreign exchange reserve management, which include transparency criteria (IMF (2003)). These, however, are quite general and allow ample room for discretion.

<sup>22</sup> In Europe, an additional important institutional change influencing the management of reserves – arguably a change classifiable as one in external governance – has been the establishment of the euro area and the European Central Bank. Since then, reserves at the national central banks have been only a second line of defence for intervention. Together with the rather closed nature of the euro area, this has induced a greater focus on return; see, in particular, Hakkarainen and Pösö (2007). The establishment of the euro also meant that those reserves held in legacy currency were transformed into a euro portfolio, and are typically managed with less of a focus on liquidity and safety (Bakker and van Herpt (2007)).

## 4.1 What risk-return balance?

While the shift towards a greater investment orientation in reserve management has naturally promoted a more return-oriented approach, there are no obvious criteria for establishing what the right balance between risk and return should be, ie for determining the institution's risk tolerance. A key challenge for central banks is that they are multi-functional institutions, so that the right balance can only be defined within that broader setting. The overriding goals of central banks are typically couched in terms of monetary, financial and macroeconomic stability. This imposes a series of constraints on reserve management operations, as these should not interfere with, and at best should support, those overriding goals.

This means that the lens through which a central bank assesses the gains and losses on a portfolio is naturally quite different from that of an institution exclusively dedicated to reserve management, let alone a private sector agent. This lens is the source of what, on balance, appears as a "conservative bias" in reserve management. Let us consider, in turn, the costs of losses, the benefits from gains and the way the "true" economic net marginal return on, or opportunity cost of, reserves may be determined.

For a central bank, losses on the foreign exchange portfolio matter not so much for their intrinsic pecuniary value. Rather, the main concern is with their impact on either the institution's reputation – eg the charge of incompetence – or on other factors that might undermine its operational effectiveness, not least its operational independence. As noted earlier, for instance, reputational concerns are generally the main reason why central banks attach so much importance to losses associated with credit events.

Beyond this common element, the significance of these considerations is highly country-specific. It depends on factors such as accounting conventions, the rules for the distribution of profits to the government and for recapitalisation, and broader aspects of the relationship of the institution with the body politic.<sup>23</sup> In general, the more extensive the use of mark-to-market accounting, the greater is the volatility of reported profits, which can increase the potential role for reputational concerns.<sup>24</sup> Similarly, the greater the sensitivity of rules for the distribution of central bank income to the government to such valuation effects and the more asymmetric the rule (whereby profits are distributed but losses are not replenished through automatic recapitalisation), the greater is the concern with the potential depletion of central bank capital.<sup>25</sup>

For example, some central banks attach considerable importance to the potential impact of reserve losses on their profits and capital position. These concerns can be formalised through analyses that consider how the composition of reserves can affect the risks to which the institution's income and capital position are exposed (Srejber (2006)). They can also have a material effect on reserve management strategies. For instance, the Central Bank of Chile takes this logic quite far, and determines the target duration for its portfolio based on the average duration of its *whole* balance sheet (Central Bank of Chile (2006)). And the Dutch central bank has gone to the extreme of hedging the whole foreign currency risk of its reserves (Bakker (2007)).<sup>26</sup> Other institutions, by contrast, may be far less concerned.<sup>27</sup>

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<sup>23</sup> A detailed assessment of how accounting and disclosure rules may interact with arrangements for the distribution of income to the government and for recapitalisations in affecting reserve management decisions is beyond the scope of this paper.

<sup>24</sup> As Table 4 confirms, while in the formal analysis of returns and risks central banks generally use mark-to-market measures, the official accounting for the profits/losses of the central bank as a public sector entity is often different.

<sup>25</sup> For a discussion of these issues, see eg Bakker (2007) and Ferhani (2007).

<sup>26</sup> This is of course functionally equivalent to financing foreign exchange reserves by borrowing in foreign currency.

Just as in the case of the costs of losses, the perceived benefits from gains are strongly mediated by the institutions' primary goals. These can significantly inhibit the investable universe and the degree of active management. Reputational concerns, again, are key. The performance of financial stability functions plays an important role. For example, it could be potentially embarrassing for a central bank to invest in high-risk high-return asset classes or investment vehicles that may have been identified as potential threats to financial stability (eg hedge funds) or to be seen as contributing to a search for yield that may have been similarly criticised.<sup>28</sup> Likewise, self-interested return-seeking behaviour may at times result in responses that are inconsistent with the broader stability of the markets. For example, retrenchment at times of stress could itself induce further stress in the markets, as assets whose returns are plunging are sold or hedged. This potential conflict increases as central banks push the envelope of risky asset classes:<sup>29</sup> contrary to high-quality government bonds, these asset classes are more likely to suffer at times of turmoil, rather than benefiting from safe haven flows.<sup>30</sup>

Admittedly, there are ways in which such risks can be mitigated. One is to invest in the more risky asset classes through asset managers rather than directly, thereby in part shielding the central bank from any criticism associated with specific choices. Another is to limit the degree of active management while still broadening the universe of asset classes in the portfolio. Notably, the central banks in the survey that had a tactical asset allocation layer in place tended to be quite cautious in using the permissible room for manoeuvre.<sup>31</sup> The trend towards a broadening of asset classes should not be equated with one towards more active asset management. Even so, tight limitations and trade-offs remain.

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<sup>27</sup> The potential relevance of the rules for the distribution of profits for this concern is highlighted in documents of the Norges Bank, where it is argued that "The accounting profit/loss risk has not influenced the investment strategy for the foreign exchange reserves, but has been important in the establishment of the rules and regulations for allocating Norges Bank's profit" (Norges Bank (2005)).

<sup>28</sup> At the same time, from a broader perspective, and somewhat paradoxically, a conservative attitude in reserve allocation need not result in less risk-taking in financial markets generally and may actually encourage it. This can be the case if other market participants are considerably more risk loving than the institutions managing the reserves. For example, in recent years a hotly debated issue has been the extent to which the combination of unprecedented reserve accumulation and the concentration of the proceeds in US government paper may have put downward pressure on Treasury yields (see eg Archer (2006), BIS (2005b), Bernanke et al (2004), Genberg et al (2005), McCauley and Jiang (2004), Roubini and Setser (2005) and Warnock and Warnock (2005)). To the extent that this effect has compressed risk premia in such a key asset class, it may have contributed to the more generalised search for yield observed in recent years. On the search for yield and the role of low interest rates, see, for instance, BIS (2004). But even if this effect has been operating, the reputational costs are not obvious, as the link is much more indirect, less apparent and harder to determine.

<sup>29</sup> Of course, this conflict is already quite familiar in the context of the impact on exchange rates themselves, at least for the larger reserve holders.

<sup>30</sup> Similarly, concerns with reputation also imply constraints on internal decision-making processes. These are shaped by the need to ensure that the profits on reserve management operations do not result from the inappropriate use of "inside" information at the central bank, which might be gained in the context of the performance of the primary policy functions.

<sup>31</sup> Concerns with conflicts of interest in internal corporate governance may be an additional factor constraining the use of the tactical room for manoeuvre. As noted earlier, in order to increase the likelihood of profitable tactical allocations, the corresponding decisions should be made by staff who are senior enough to have a sufficiently broad overview of markets and of the policy considerations relevant for the central bank. But to avoid the risk of using inside information, or being seen as potentially using it, they may need to be sufficiently far away from that process. At a practical level, it is not always clear that staff with these qualifications exist, particularly in smaller central banks. The design of investment committees for making tactical asset allocation decisions is an open issue, and there is significant variety in the way these decision-making bodies are structured: in some central banks members of the executive are involved in tactical decision-making, while in others they are specifically prohibited.

Finally, the true *economic* marginal return and marginal opportunity costs of foreign exchange reserves arguably bears only a loose relationship to the pecuniary returns on, and financing costs of, the portfolio. The distinction between a partial and general equilibrium analysis is crucial. In a partial equilibrium sense, the proximate net return on the reserves may be approximated by the return on the portfolio minus the cost of its financing, typically associated at the margin with sterilisation operations.<sup>32</sup> This is the type of analysis that focuses on the carrying cost of reserves, possibly adjusted by expectations of exchange rate changes, and which often proxies the return on reserves with that on, say, a US Treasury bill rate. But the perspective offered by a general equilibrium analysis is more relevant. The key question, in fact, is how different the path of the macroeconomy would have been had the level of the reserves been different at the margin. The answer depends critically on views about how the economy works, including views on the effectiveness of foreign exchange intervention.

This general equilibrium perspective casts a different light on the meaning of, and desirability of, a “return-oriented” strategy. For, to the extent that the net economic (non-pecuniary) return on reserves is regarded as positive, the rationale for seeking higher pecuniary returns is arguably weaker. Consider the following example, applying in particular to so-called “excess” reserves, ie those in excess of insurance needs.<sup>33</sup> Assume that the accumulation of reserves is the result of an exchange rate policy which aims at, and succeeds in, boosting export-oriented growth. Then the true returns on the reserves would be in terms of the higher output that they yield, and their opportunity cost could not be defined in terms of, say, infrastructural projects foregone (see eg Summers (2006)): the financing of the projects with the reserves would call for an unwinding of the net foreign exchange position, which in turn could negate some of the benefits of a more competitive exchange rate.<sup>34</sup>

Looking forward, *other things equal*, the structural trend towards higher risk tolerance in reserve management may well continue. Despite some of the above considerations, which highlight a number of limitations and trade-offs involved, the pressure to earn additional returns on reserves remains strong, not least from the body politic and in those countries where excess reserve levels are perceived as high.<sup>35</sup> Given the generally “conservative bias” of central banks, this would support further the current trend towards “locating” the reserves

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<sup>32</sup> Of course, on the assumption that uncovered interest parity (UIP) holds over the relevant horizon, the net return on the reserves would be zero, except for risk premia associated with duration, credit and liquidity considerations. This is a common assumption for strategic asset allocation purposes, amounting to a zero risk premium on currencies. The empirical evidence, on balance, suggests that UIP does not quite hold, at least over typical horizons; for a survey, see Isard (2006) and, for evidence beyond short maturities, see Remolona and Schrijvers (2003). Even so, in the absence of hard estimates, there is a preference to leave the possible exploitation of deviations from UIP to tactical decisions.

<sup>33</sup> It is commonly, and correctly, assumed that the insurance services provided by reserves are an important source of (non-recorded) economic “returns” on the portfolio (see eg Jeanne and Rancière (2006), Jadresic (2007)). The point here is that this type of analysis can also be extended to “excess” reserves. Of course, if one was of the view that reserve accumulation failed to prevent the appreciation of the currency (ie that sterilised intervention was completely ineffective), then no such economic return would be discerned.

<sup>34</sup> True, *for a given stock*, adjustments in the portfolio allocation can help to gain additional returns, by exploiting risk premia embedded in the prices of the assets. As noted above, a central bank would assess the benefits of such a strategy in terms that are rather different from those of a private sector asset manager or a single-task institution.

<sup>35</sup> We would argue that, to the extent that (a) reserves are truly considered to be in “excess” of any insurance needs; (b) their net portfolio cost is negative (eg because of a differential risk premium paid by the sovereign/country); and (c) they can be reduced without any negative consequence for the exchange rate (eg by reducing foreign currency liabilities of the consolidated government sector balance sheet), then the first best solution would be to eliminate them. See Rodrik (2006) and El-Erian (2007) for a similar point and Williams (2007) for a discussion of the issues raised by reserve management in the broader context of the government sector balance sheet.

in separate SWFs. Indeed, other things equal, the accumulation of reserves actually heightens that bias, by increasing the sensitivity of central banks' profits and capital position to fluctuations in the value of the reserves.

Such relocation can address some tensions between the pursuit of competing goals, but may create others. It can help to relieve *central banks* from tensions in the pursuit of their competing objectives. But it does not necessarily attenuate, and may actually heighten, the potential pressure points in the broader economic relations between sovereign states. This is precisely the result of the greater degrees of freedom in portfolio management that such separate funds enjoy. The current debate on the need for an international code of conduct for SWFs is the most concrete manifestation of the tensions that can arise (see eg Lowery (2007), OECD (2007), IMF (2007) and Truman (2007)).

## 4.2 Which numeraire?

At the more operational level, the choice of the numeraire (unit of account) is an integral part of the choice of the appropriate risk-return balance for the institution. This is because the numeraire is what is actually used operationally to measure the (pecuniary) risks and returns involved. Thus, different numeraire choices would generally imply different optimal allocations (see eg Papaioannou et al (2006), Borio et al (2008), McCauley (2008)). The adoption of a more structured and formal approach to reserve management and the availability of more sophisticated financial tools have recently highlighted the importance of this choice, which would have remained more implicit in the past.

The numeraire that is relevant in this context is the unit of account that underpins reserve management decisions. This can, and often does, differ from the unit of account used for accounting purposes, invariably the domestic currency. And it may, or may not, be the unit in which the returns from reserve management per se are publicly reported.

The range of numeraires in use revealed by the BIS survey is indicative of the potential challenges involved and of a considerable variety of practices. Around one third of central banks used the domestic currency, one fifth a basket of currencies and the remaining set a single foreign currency. One third of surveyed institutions used the US dollar. Some institutions used multiple numeraires, which varied depending on the tranche involved.

In principle, the choice of numeraire presupposes a careful analysis of the intended uses of the reserves and of the institutional factors that influence the risk tolerance of the central bank (see Box 2 in Borio et al (2008)).

If reserves are held primarily for intervention purposes, an obvious candidate for the numeraire would be the most liquid currency used for interventions. On this basis the US dollar offers the most logical choice for most central banks: it trades on one side of over 85% of all foreign exchange transactions, and is the most liquid exchange rate for most currencies apart from some European currencies, which have more liquid trade against the euro (BIS (2007b)).<sup>36</sup> If reserves are considered mainly as providing insurance (a "hedge") for access to purchases of foreign goods and services, then an import basket would be reasonable.<sup>37</sup> By contrast, if they are seen as hedging primarily capital account transactions, the currency composition of those liabilities would be more relevant. One central bank in the survey, for

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<sup>36</sup> The sheer size and liquidity of the markets for the underlying instruments, which need to be sold to finance the intervention, supports this advantage. For an analysis of this specific aspect and of how markets denominated in euros have been closing the gap, see Galati and Wooldridge (1996).

<sup>37</sup> For an elaboration on this point, see in particular Ben-Bassat (1984), who also refers to previous work along these lines.

instance, used the composition of its liabilities as the numeraire for a dedicated liabilities tranche, and an import-based set of weights for its main tranche.

There are at least two possible reasons for using the domestic currency as the numeraire. First, especially in countries where reserves exceed liquidity/insurance needs and the investment motive dominates, the domestic currency might be seen as a better guide as to whether domestic wealth is being maximised – even though, being debt-financed, strictly speaking these reserves do not represent net wealth.<sup>38</sup> In addition, as the domestic currency is what determines reported losses for accounting purposes, it is a natural candidate for those institutions that are particularly sensitive to such losses, seen as possibly impairing their reputation or operational independence, not least by threatening their capital base.<sup>39</sup>

The choice of numeraire can have first-order implications for strategic asset allocation across currencies. If it is assumed that expected returns are equalised across currencies over the long term – a common assumption when deciding on the strategic asset allocation – the choice of numeraire influences the currency composition of the benchmark portfolio primarily through its impact on the measured variability of returns. Specifically, the currency composition of reserves will be heavily tilted towards the foreign currency, or basket, used as the numeraire. And if the domestic currency is used as the numeraire, portfolio allocations will be tilted towards those currencies vis-à-vis which the domestic currency is more stable. This in turn raises the importance of the exchange rate regime, or of the way market forces drive exchange rates, in the choice of currency allocation.<sup>40</sup> In cases where the exchange rate is fixed, or heavily managed, the composition of reserves will reflect the currencies or basket of currencies being tracked. In general, the currency composition of reserves derived on the basis of a domestic currency numeraire is less balanced than those based on import shares (McCauley (2008)).<sup>41</sup>

Based on this analysis, one should expect the domestic currency to have been gaining ground as a numeraire choice. Domestic wealth maximisation considerations have become more prominent alongside the unprecedented accumulation of reserves by some countries.

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<sup>38</sup> As a guide to wealth maximisation, however, the domestic currency is only an approximate solution. Strictly speaking, a numeraire representing a representative “consumption” bundle (in real terms), including a basket of *both* domestic and foreign goods/services, would be conceptually superior.

<sup>39</sup> The discomfort of central banks in requesting recapitalisation from the government as a possible reason for the choice of numeraire had been noted even before they gained greater independence (eg, Heller and Knight (1978)).

<sup>40</sup> For previous evidence on the role of the exchange rate regime (peg) in currency allocation, based on IMF confidential data, see Heller and Knight (1978), Dooley et al (1989) and Eichengreen and Mathieson (2000). Heller and Knight (1978) note the influence of a peg based on both mean-variance considerations and the so-called “transactions motive”, ie as affecting the intervention currency which minimises transaction costs; the other two studies appear to stress the transactions motive (see also Roger (1993) for a review of some of the work on these two approaches and an alternative perspective on the role of intervention). In general, however, the most effective (liquid) intervention currency need not be the one vis-à-vis which the domestic currency trades most tightly, although they may empirically coincide. Papaioannou et al (2006), *inter alia*, with particular reference to pegs, note the quantitative importance of the choice of numeraire in a mean-variance framework by comparison with transaction costs. They do not, however, discuss the merits of the choice of alternative numeraires as such.

<sup>41</sup> It goes without saying that a proportionate depreciation of the domestic currency vis-à-vis all the currencies held in the reserves could not be insulated by varying their currency composition. Moreover, assessing the performance of reserve management activities using the domestic currency as numeraire when fluctuations in the value of the reserves are dominated by such changes can cloud the underlying picture. For instance, it would generate a loss whenever the domestic currency appreciated against all others. One way of dealing with this problem could be to use a two step procedure: first, to choose the benchmark currency composition by minimising the variation of its value vis-à-vis the domestic currency; second, to use that benchmark as the (basket) numeraire in evaluating the performance of reserve management activities and in communicating that performance externally.

And concerns with retaining independence and the greater public scrutiny of central banks have worked towards raising these institutions' sensitivity to losses.

The available evidence, while patchy and tentative, is broadly consistent with this hypothesis. For example, McCauley (2008) finds evidence that a shift towards the domestic currency as numeraire may well have taken place, by comparing the currency composition of those reserve holders for which information is available with estimates of the composition that would be consistent with the various options for the numeraire. Similarly, a number of central banks have publicly rationalised adjustments to their portfolio allocations with the desire to limit the variability of the value of the portfolio measured in domestic currency (see eg Riksbank (2006), Central Bank of Chile (2006)).

Looking forward, unless reserve accumulation is reversed and the value of central bank independence is questioned, the use of the domestic currency as numeraire could gain further ground. Moreover, any further shift of funds out of central banks to SWFs would reinforce it. So too would a more widespread adoption by central banks of International Financial Reporting Standards (IFRS), not least on reputational grounds, as this would increase the weight of fair value (marked-to-market) elements in accounting and hence reinforce aversion to losses measured in domestic currency.<sup>42</sup>

Such a trend could potentially have implications for the future of the US dollar as the unrivalled reserve currency. A more extensive adoption of the domestic currency as numeraire could reduce the resistance of official reserve holders to balance their strategic benchmarks away from the dollar, especially if the arguments based on the intervention motive were to lose relevance. Correspondingly, the role of the exchange rate regime would become more important. Against this background, calls for greater flexibility of Asian currencies vis-à-vis the US dollar and the questions raised about the continuation of a US dollar peg in the Middle East acquire particular significance. The shift of some central and eastern European economies towards the euro is also consistent with this view. Admittedly, these considerations apply only to official reserve holders. Even so, private sector participants watch such decisions quite closely (Truman and Wong (2006), Papaioannou et al (2006)).<sup>43</sup>

### **4.3 How much public disclosure?**

The choice of the degree of appropriate public disclosure depends on two types of considerations. On the one hand, it hinges on views concerning the appropriate external governance arrangements for the institution managing the reserves. On the other hand, it is influenced by views concerning how disclosure can affect the effectiveness with which the institution can carry out its reserve management activities, as part of the broader set of functions that it may perform.

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<sup>42</sup> This is a positive, not a normative, statement. Views differ concerning the desirability for central banks to adopt IFRS. Most likely, this would depend on country-specific circumstances, including the characteristics of broader governance arrangements.

<sup>43</sup> For a more detailed analysis of the shifts, or lack thereof, in the currency composition of official portfolios and prospects based on various considerations, see Wooldridge (2006) and Galati and Wooldridge (2006). Compared to the analysis here, these studies play down the role of the relevance of the currency regime for the store of value motive. For broader analyses of the future of the euro and the dollar as international reserve currencies, see also, in particular, Frankel (1995), McCauley (1997), Eichengreen and Frankel (1996), Eichengreen (1998), Eichengreen and Mathieson (2000) and Chinn and Frankel (2006); and for some recent empirical evidence from a historical perspective, highlighting the role of trade and liquidity premia, see Flandreau and Jobst (2006).

External governance arrangements are highly country-specific. They depend on a broad set of institutional factors that govern the running of public sector bodies and aspects of the legal environment. It is no coincidence that those countries that rank high in disclosures concerning reserve management practices generally rank high in disclosure standards in other areas, including other central bank functions, the activities of public sector bodies and the organisation of financial activity more generally. For instance, this seems to be the case for common law countries (La Porta et al (1998)).<sup>44</sup>

Assessments of the impact of disclosure on the effectiveness with which reserve management functions can be performed are more amenable to strictly economic considerations. At the risk of some oversimplification, the optimal degree of disclosure can be seen as involving a trade-off between the efficiency-enhancing effects of providing additional information to financial markets, on the one hand, and the loss of tactical room for manoeuvre for the reserve manager, on the other. Therefore, differences of view hinge on differences in perspective on how well markets function and on how much disclosure can constrain the authorities' ability to pursue their objectives.<sup>45</sup> Given these factors, they can also depend on specific characteristics of the economic context in which reserve management is carried out. Two such specific characteristics are the size of the reserves and the nature of the exchange rate regime.

If foreign exchange reserves are very large, then the assumption that the central bank is an atomistic player in foreign exchange markets and in the instruments in which it invests is less likely to hold. This would suggest a greater reluctance to disclose information about the currency and asset allocation of the reserves. The institution, for instance, may become more concerned that private sector participants might "front run" its intended moves. Interestingly, this consideration points in the opposite direction to the stronger calls for transparency and public accountability that might arise when the stock of reserves grows to represent a larger fraction of a country's resources.

It could also be argued that, the more tightly and actively managed the exchange rate, the higher may be the reluctance to disclose information about reserve management activities (eg Knight (2006)). In such regimes, the need for tactical room for manoeuvre may be greater. To be sure, these arguments apply more to foreign exchange intervention per se than to changes in the composition of reserves. Even so, information on currency composition could help decompose ex post changes in the level of reserves due to valuation effects and those due to intervention activities.<sup>46</sup> Moreover, as discussed above, there is a link between the currency composition of reserves and the exchange rate regime, especially if the domestic currency is used as numeraire. If so, there is a risk that changes in the currency composition could be interpreted as foreshadowing changes in a managed exchange rate regime. Regardless of whether the inference is correct or not, it would not be welcome.<sup>47</sup>

The influence of all these factors on actual country choices is hard to disentangle. For example, countries with heavily managed exchange rate regimes also tend to be those

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<sup>44</sup> Specifically, La Porta et al (1998) find that common law countries are associated with more capital market intermediation, which goes hand-in-hand with greater disclosure.

<sup>45</sup> See, for instance, the discussions of the value of disclosure in Truman and Wong (2006), who argue that, if properly structured, greater disclosure about reserve management activities can actually help to stabilise markets. See also Archer (2006).

<sup>46</sup> Views concerning the extent to which disclosing information on intervention activities may help or hinder their effectiveness vary substantially across countries, and are reflected in differences in country practices; see Chiu (2003), BIS (2005a) and Neely (2007).

<sup>47</sup> As regards the impact of changes in currency composition on the exchange rates of the two reserve currencies that are being exchanged, the impact is equivalent to that of sterilised intervention (see Genberg et al (2005) and Archer (2006)).

where reserve accumulation is greatest. On balance, though, traces of their influence can be detected (Table 9). For example, the only large reserve holder that discloses its currency composition is Russia. Monetary authorities with free-floating regimes, in which there is no or only rare intervention, appear more likely to disclose, including, for instance, a number of English-speaking and Nordic countries. In many of these cases, however, the influence of broader institutional factors is also probably at work, given consistently strong disclosure practices in other areas too. These broader institutional factors, together with the rather transparent nature of the currency board arrangement, may go some way towards explaining the comparatively high degree of disclosure in Hong Kong SAR.

Looking forward, it will be interesting to see how disclosure practices evolve. The evolution could turn out to hinge on the balance between two types of forces: on the one hand, external pressure to disclose, especially from the countries in whose currencies and assets reserves are being invested and, on the other hand, a certain reluctance to do so on the part of especially large reserve holders. The evolution of exchange rate regimes could also play a role, with moves towards more flexible arrangements likely attenuating the resistance.

## 5. Conclusion

Reserve management practices have evolved substantially in recent years. In the process, they have increasingly come to resemble asset management practices more generally. There has been a gradual shift towards more return-oriented strategies, as most concretely manifested in an expansion of the investable universe, greater reliance on external managers and the setting-up of dedicated SWFs. Decision-making has become more structured, with the adoption of more top-down approaches to the design and implementation of investment strategies and an increase in the functional separation of specific aspects of the process. Risk management, for both financial and operational risks, has been strengthened. This upgrading of internal governance has gone hand-in-hand with a greater degree of public disclosure, a key component of external governance. Despite these common trends, and the accompanying tendency towards convergence, cross-country differences remain considerable.

There are several, sometimes interacting, drivers of the above trends. For some countries, the unprecedented accumulation of reserves has been important. It has naturally encouraged a shift towards more return-oriented strategies and added to pressures for greater accountability in the management of a growing fraction of a country's resources. More generally, the development of financial markets and financial technology has improved the trade-off between liquidity and return while providing the tools for more rigorous asset allocation and risk management. Likewise, the broad trend towards greater central bank independence has increased the emphasis on accountability and transparency, encouraging a strengthening of both internal and external governance, including through greater disclosure. Moreover, the upgrading of internal governance and the adoption of more return-oriented strategies have been mutually supportive.

These trends have heightened several challenges for central banks. In this paper we have focused on the three that have more immediate implications for the functioning of markets: the choices of an appropriate balance between risk and return, of the numeraire for reserve management and of the extent of public disclosure.

With respect to choosing the appropriate balance between risk and return, we highlighted two sets of complications. One arises from the fact that the economic return, and hence the opportunity cost, of reserves can only be properly assessed in a general equilibrium context. The other reflects the fact that the appropriate balance can only be adequately evaluated within the broader set of functions performed by central banks, notably their overriding pursuit of monetary and financial stability. Taken together, these factors induce a degree of

conservatism in the running of the reserves compared with the standards applied to asset management generally and an evaluation of reserve management on a stand-alone basis. This apparent conservatism, in turn, helps to explain the trend among the largest reserve holders towards establishing dedicated funds, SWFs, for the management of portions of their reserves. Beyond this, the country-specific institutional environment, notably external governance arrangements, can have a material influence on the chosen balance between risk and return.

The choice of numeraire (unit of account) can have a first-order impact on the strategic asset allocation across currencies, as it determines how risks and returns are measured. Its main effect is to tilt the structure of the portfolio towards the numeraire itself, thereby minimising the variability of returns. We argued that, for a variety of reasons linked to the recent large accumulation of reserves and the greater value attached to central bank independence, the domestic currency is likely to have been gaining ground as numeraire relative to the preferred intervention currency or to baskets of currencies. The available empirical evidence seems to be consistent with this. This shift, in turn, raises the significance for asset allocation of the exchange rate regime and of the way a currency fluctuates in relation to others.

The perceived merits of greater disclosure depend on a mix of different factors. We highlighted three in particular: features of the broad institutional environment, which influence governance arrangements; the size of the country's reserves, which may invalidate the common assumption that the reserve holder is atomistic and unable to influence market prices; and the exchange rate regime, which may affect the desired tactical room for manoeuvre in operations. The observed cross-country pattern of disclosures appears to support the relevance of these factors.

Looking forward, how the various challenges are addressed could have significant implications for the markets. We noted how, in an increasingly globalised world, a more return-oriented strategy could potentially heighten the tension between individually profitable behaviour and shared responsibilities of public sector authorities for public goods, such as well functioning markets and financial stability. Locating asset management functions outside central banks, such as in SWFs, would alleviate the conflict for the central banks but possibly exacerbate it more generally, not least by encouraging more active management styles. We also argued that, were it to take hold, a trend towards using the domestic currency as numeraire could potentially contribute to weakening one of the sources of inertia inhibiting a shift away from the US dollar as the unrivalled reserve currency. This would be so especially if accompanied by the adoption of more flexible exchange rate regimes in the so-called US dollar block.

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