Centre for Central Banking Studies

Foreign exchange reserves management

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BANK OF ENGLAND

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Abstract

For many countries, especially in the emerging markets, the official foreign exchange reserves are both a major national asset and a crucial tool of monetary and exchange rate policy. It is vital therefore that this national resource is used and managed wisely and effectively.

Management of reserves is a complex and time-consuming business. It requires clear objectives, extensive delegation, strong control systems, open and transparent reporting and a realistic appreciation of the constraints faced. If conducted properly, openly and successfully it will greatly strengthen the public's respect for and confidence in official policy, and can make a material contribution to successful macro-economic management.

This *Handbook* is not, and does not set out to be, a guide to the details of the market or of portfolio management. Still less is it a primer on bond mathematics. Information on these can be found from many sources, not least the market itself. Rather it explores the strategic issues facing those who set their country's policy for the official reserves. A correct and appropriate policy framework for the official reserves is the most important element of successful reserves management; without it, even the most technically accomplished portfolio management operation will fail to be strategically successful.

1 The decision to hold FX reserves

1.1 Introduction

Countries differ in a very great number of ways; for example size of population, types of government system, state of development, wealth, openness to international trade, even between those who borrow exclusively in their domestic currency and those who also borrow in foreign currency. But despite this, in nearly every case they see a need for holding foreign exchange reserves. Moreover, this is as true of countries with large self-sufficient economies (eg the USA) as it is of smaller, more open ones.

In many cases, the official reserves are a major national asset. Even in the rich and developed economies, reserves can measure several percentage points of GDP. In some emerging countries, the corresponding figure is considerably higher. Merely from the standpoint of preserving this national asset, therefore, the management of official reserves is an important one for almost all central banks. But beyond this, poor management of the reserves may put at risk other elements of national policy (for example, an official exchange rate policy), and this can cause severe economic damage out of all proportion to the financial loss suffered on the assets themselves. This means that the management of official reserves assumes a doubly important role for the authorities: in many cases not only is a large amount of money at stake, but also significant elements of national economic policy.

This handbook will explore the policy issues that arise in official reserves management. It does not set out to be a guide to the details of the market or of portfolio management. Still less is it a primer on bond mathematics. Information on these can be found from many sources, not least the market itself. Rather it explores the strategic issues facing those who set their country's policy for the official reserves. A correct and appropriate policy framework for the official reserves is the most important element of successful reserves management; without it, even the most technically accomplished portfolio management operation will fail to be strategically successful.

1.2 The reasons for holding reserves

Although almost all countries hold foreign exchange reserves, their reasons for doing so differ widely. Before setting a strategic policy for the reserves, the authorities need to establish precisely why they are holding the reserves that they have. Only then can a sensible debate be held on such issues as the optimum size of the reserves, their funding and their investment.

The following are some of the main reasons for holding reserves:

Reserves are sometimes held as **formal backing for the domestic currency**. This is a very traditional use of reserves, especially gold reserves. This use of reserves was at its height under the gold standard, and survived after the Second World War under the Bretton Woods system. After the breakdown of the Bretton Woods system it became less common, though the use of gold especially to back a currency has never completely disappeared, and the idea of using foreign exchange reserves (rather than gold specifically) to back and provide confidence in a domestic currency has recently been revived with the rediscovery of currency boards. Nevertheless, for most countries this is not, these days, the prime use of the reserves.

More common is the use of reserves as a **tool of exchange rate or monetary policy**. This is most obviously the case for those countries who are pursuing a fixed exchange rate policy, and who wish to be able to influence the market in their domestic currency so as to maintain a fixed rate. In addition, countries may choose to use the FX markets to affect domestic monetary policy, by supplying domestic currency to the market or buying it in the market against foreign currencies. This will affect the domestic money market balance and so domestic interest rates, and is a useful tool for those countries whose domestic markets are not yet fully developed. But even countries whose domestic markets are fully adequate for the exercise of monetary policy and whose currency is floating may wish to intervene to "manage the float" to affect the rate at which their currency trades. Only a very few countries have decided not to intervene on the exchange markets at all (a "free float" of their currency) – and even for these countries, holding reserves preserves the option to intervene or move to a more managed float later if circumstances or policy change.

A third use of reserves is to provide funds for **servicing foreign currency liabilities and debt obligations**. Clearly foreign currency is needed at the point in time when debt servicing payments fall due, to avoid a default. While it would be possible to meet this need for foreign currency by buying it in the market (ie by selling domestic currency) as and when the need arises, this is not a course that many countries pursue, for several reasons:

- the FX markets might be unfavourable at the time that foreign currency is needed;
- the transactions might be disruptive to the markets;
- the strategy entails large open currency risks on the liability portfolio;
- this approach reduces credit rating agencies' confidence in the country as an issuer, and as a result both reduces the attractiveness of the country to lenders and increases the cost of foreign currency borrowing.

Instead, therefore, most countries that have borrowed in foreign currency will aim to use some of their reserves to provide a fund for servicing at least the part of their debt which is falling due in the near future.

Reserves can also be held as a **source of funds to pay for government expenditure overseas**. For many countries, especially those with known import bills for the authorities to meet, it can be sensible to plan their financing using the reserves. This is particularly the case when either foreign exchange receipts or outflows are "bumpy" or show a marked seasonal pattern. In these cases the reserves can be used to smooth out the payment schedules.

Reserves can provide a **defence against emergencies or disaster**, by acting as a fund to finance recovery and rebuilding. This is most likely to be appropriate for small countries that are not large enough to provide self-insurance; larger countries are more likely to fund recovery from a crisis in one part of their domestic economy from elsewhere in the economy. But a small country may possibly be completely overwhelmed by a disaster; for example, a natural disaster that wipes out the only export, or a collapse in their terms of trade, or even military disaster. For such events reserves can provide a diversification of assets, a pool of readily usable funds and security and comfort for potential lenders.

Finally, reserves may be held as an **investment fund**, primarily for financial gain. This will not be a sensible reason for holding reserves for the majority of countries; few countries will find that the monetary income on their reserves represents the best use of those assets in the wider context of their whole economy. But for some countries, an investment fund can be a logical policy, for example:

- in cases where the local economy cannot absorb more spending without overheating;
- where windfall profits would otherwise disrupt the domestic economy;
- to prepare for a less certain future (perhaps as a natural resource runs out);
- to diversify a small country's asset base.

For any country, the reason it holds reserves will play a very important part in planning how those reserves should be managed and in what way they should be invested. Policymakers who are planning their country's reserves management, therefore, should start by running through the checklist above to identify the reasons for holding reserves. Reserves held for no identifiable reason are seldom optimally used; indeed, in many cases, the optimum treatment for

reserves for which no other use has been identified may even be to return them to the taxpayer. (Countries which do decide that their reserves holdings are larger than they need may need to exercise care in disposing of them to avoid running them off too quickly for the market to absorb; but this is a market timing issue not one of the optimum level of reserves).

1.3 Funding the reserves, and the cost of holding reserves

Many people see the reserves as an asset portfolio only; that is, with no corresponding liability. This leads to much debate on the correct investment of the reserves, but rather less on how the assets have been acquired. This is a partial picture only, and a better approach includes a consideration of the funding of the reserves. Only in this way can the true cost to the authorities of holding reserves be ascertained.

There are broadly speaking three ways to fund the reserves. They have in common the starting point that the authorities do not naturally hold assets in any currency other than their own, and that to acquire and hold foreign currency assets is therefore a conscious decision involving foregoing domestic assets. In essence, holding foreign exchange assets means that the authorities have decided not to hold domestic assets, and it is in this light that the issue of funding the reserves should be addressed.

The three methods of acquiring foreign exchange assets are to borrow foreign currency formally (eg through an international bond issue), to borrow foreign currency against domestic currency through the FX swap market, or to buy it outright against the domestic currency. (Note that foreign currency income on existing assets, eg coupon or interest income, can actually be considered a form of outright purchase against the domestic currency. This is because the authorities have decided not to sell the foreign currency income, so they have increased their outright position of long foreign currency, short domestic currency).

The three methods of funding the reserves have differing effects on the market:

- Borrowing, whether via a foreign currency bond issue or some other means (eg an international loan) does not affect the FX market (ie exchange rate) directly at all. There has been no transaction in the domestic currency and so there should be no direct effect on the exchange rate.

- FX swapping has timing effects only on the FX market. This is because although there is a transaction in the spot market to sell domestic currency and acquire foreign currency, there is an equal and

opposite deal done for settlement in the future. So the overall level of the exchange rate should not be unduly affected.

– Outright purchases of foreign exchange against sales of domestic currency can affect the exchange rate however, as the overall supply of the domestic currency to the market has been permanently increased.

The value of this analysis of the funding of the reserves is that it enables the authorities to ascertain the true cost of holding reserves. If the reserves are treated simply as an asset portfolio with no funding or corresponding liabilities, the income on the reserves looks like a net gain for the authorities. An approach which takes into account the true method of funding the reserves will show that in many cases the net financial outcome from holding reserves may even be a loss, especially in those cases where comparatively low-yielding foreign assets are financed with higher-yielding domestic borrowings. And even a positive return may not be optimal; the key question is whether higher returns, after allowance for risk, could be made elsewhere (eg through investment in the country's domestic infrastructure).

The choice of which of the three methods to use to fund the reserves depends on many things, from the authorities' ability to borrow, to the state of the FX market, to the perception of the exchange rate. Cost will also play a significant role for those countries with the ability to choose between the three methods. Many countries will make use of all three methods at different times, depending on the relative costs of each method, the state of the market and the interaction with other policies.

1.4 Managing reserves against liabilities

The discussion on the importance of considering the funding of the reserves in the previous section has consequences for how reserves should be managed. One very important decision is whether the assets should be managed on their own as an asset portfolio, or in conjunction with a set of liabilities.

For many countries, the reserves are held on the central bank balance sheet, while official borrowing in foreign currency, if any, is conducted by the government, either by the Finance Ministry directly or perhaps via a debt management agency. In such a set-up, it may on the surface seem natural for the central bank to manage the reserves as a straight asset portfolio, ie in isolation to any foreign currency liabilities. And indeed the foreign currency borrowing may similarly be managed independently as a straight liability portfolio.

This approach fails however to take account of the fact that while the central bank has just an asset portfolio, the authorities taken as a whole may have a balance sheet which contains foreign currency liabilities as well. And decisions which are optimal for the asset side of the balance sheet taken in isolation may prove suboptimal when the overall position of the authorities is taken into account. As an example, in managing the asset side of the authorities' position, market or interest rate risk will, other things being equal, be reduced by shortening the maturity of one's assets. On the liability side, there are however strong reasons to aim to extend the maturity of the debt, for example to reduce rollover risk (ie the risk that on refinancing the debt, terms have moved against the borrower). If the authorities manage the asset and liability positions separately, they could find that – for entirely internally consistent reasons – the average maturity of the assets are reduced while the average maturity of the liabilities are increased. The net result is an increase in the maturity mismatch on the authorities' overall or net position.

The alternative approach, used by the UK authorities among others, is to manage the FX liabilities and assets together. There are several options for the balance sheet under such a regime, depending on the ownership of the assets and liabilities. But the analysis is very similar in the three possible cases:

- where both assets and liabilities are on the finance ministry's balance sheet; or
- where both assets and liabilities are on the central bank's balance sheet; or finally
- where the central bank holds the assets and the finance ministry the liabilities, and the two enter into some formal agreement to manage the two together (for example an off-market exchange of obligations between the central bank and the government).

Whichever is the position, managing assets and liabilities together enables the authorities to focus on their net position and net risk, and this can produce a better overall result for the authorities taken as a whole.

2 Strategic issues

2.1 Ownership of the reserves: Government or Central Bank

The question of whether the government or the central bank should own the national foreign currency reserves is one to which there is no single right answer.

In most countries, the reserves are owned by the central bank; that is, they are on the central bank's balance sheet and the ultimate decisions on reserves management are taken within the central bank's management structure. But there are several counter-examples to this (the United States, the UK and Japan, to name three) where the reserves are formally owned by the government, and the ultimate decisions on their management are thus taken by the government (usually the Treasury or Finance Ministry).

For any country, the decision between the two approaches will be determined by a number of factors. Perhaps the most important one is precedent: if a structure is already in place and if it works, there is often little reason to change. But beyond that the following factors will have a bearing on the decision:

- do the reserves play any part in backing the domestic currency or the note issue? (If so, it is more logical for them to be on the central bank balance sheet);
- are the reserves used primarily for domestic monetary policy management? (Again, if so, it is more logical for them to be on the central bank balance sheet);
- are the reserves primarily used to hedge foreign currency liabilities of the government? (If so, the authorities should consider government ownership of the reserves as an option);
- how is the central bank funded? (Many central banks will see the income from the reserves as an essential element of the funding of their operational costs).

What is however more widely true is that, whoever formally *owns* the reserves, they are nearly always *managed* by the central bank – either as principal or, in the case where the assets are owned by the government, as agent. (The main exceptions to this rule are where the reserves, or perhaps a part of them, are more akin to an investment fund or "fund for future generations"; in such cases the authorities often prefer to set up a specialised investment authority to manage this portion of the reserves). Equally, whoever formally owns the reserves, they are treated identically by the international authorities (eg in the IMF statistics) as "national FX reserves".

Finally, however independent a central bank is, the ultimate decisions on a country's currency (exchange rate policy, significant intervention, union with another currency, or even "dollarisation") are usually taken by the government, and these decisions will of course have consequences for the management of the

reserves. In such cases the precise legal ownership of the reserves is of lesser importance than the need for co-ordinated policy-making between government and central bank.

2.2 Strategic objectives for reserves management

Whatever the rationale for the holding of official reserves, and whoever owns them in the legal sense, there are three common features of official reserves management. First, the assets are public assets. This means that the authorities will always value their security very highly: assets held on behalf of others attract a higher fiduciary duty and public assets should attract the highest concern for their safety.

Second, the assets are (in most cases) there to be used. As mentioned above in section 1.2, very few countries hold assets for their own sake, ie as some form of investment portfolio; instead, the reserves are more usually a tool with which to further government policy (usually exchange rate policy or monetary policy). This means that the assets in the reserves must always be available. Not only are they there to be used, they are there to be used in their entirety if the person controlling them, usually the Finance Minister, wishes them to be, and they are there to be used whenever he says. The reserves management operation is not the ultimate reason for holding the reserves, but an intermediary operation pending the ultimate use of the reserves. This means that official reserves management must always be conducted in such a way as to ensure that reserves are available as and when they are required. For this reason, the authorities will always prize liquidity (ie, the ability to convert assets into cash) very highly.

Finally, and as already mentioned, the reserves are often relatively large, both in absolute terms and compared to the rest of the government's finances. Therefore, returns on the reserves, while in most cases not the primary reason for holding the reserves, are not unimportant, and it is legitimate for the managers of the reserves to try to maximise that return. There has in the past been a discussion as to whether a profit-maximising motive is entirely appropriate for the authorities – many in the public sector have traditionally viewed profit as if it was something only the private sector was either suited to or even able to pursue. Increasingly, however, such sentiments are losing favour and the pursuit of returns is seen as a legitimate and central element of official reserves management. Given the amount of money that is at stake, it is now widely seen as sensible and legitimate for the authorities to invest both time and effort in the reserves management operation, to ensure that potential income is not wasted or foregone.

For these reasons – which are shared by almost all official reserves managers whatever the ultimate reasons for holding the reserves are – there is a widespread

agreement on the "classic trilogy of objectives" for official reserves management; Security, Liquidity and Return. And there is also agreement that of these, Return is in most cases the third most important of the three. One rendition of the trilogy of objectives into a combined statement of official reserves management is "The objective of official reserves management should be to maximise return, *subject to* the maintenance of sufficient security of the assets and adequate liquidity for meeting the calls on the reserves".

2.3 The optimum size of the reserves

This is an important area that is often given insufficient attention, particularly in emerging countries where the background has traditionally been one of concern over having too few reserves rather than analysis of whether the authorities have too much. Equally, there are often strong political pressures not to declare that "we have enough reserves now". Not only may there be a public perception that "reserves are good and the more reserves the better", but also, the decision to stop accumulating reserves has only downside risk: the authorities can never be shown to have too large a stockpile of reserves, but the market can dramatically expose countries that have too few reserves.

Nevertheless, reserves are a tool of the authorities and an asset to be used wisely. The debate over the optimum size should not just be ignored or put in the "too difficult" box. This is especially true for emerging economies, for whom reserves are an expensive asset (in the sense that they cost more to fund than they earn in income) which must therefore be used sparingly.

Any debate over the optimum size of the reserves has two main elements. The first is the correct identification of the uses of the reserves and therefore of the minimum required to meet the identified needs. No sensible discussion of the optimum size of the reserves can take place before this has been done. The second element is a correct analysis of the cost of funding the reserves. The debate over limiting the growth of the reserves will be easier to conduct if the true cost of reserves accumulation is known.

These two elements together provide a lower bound to the reserves (enough to meet the uses identified) and a pressure not to increase the reserves without limit above that. It is not possible to identify the precise level that corresponds to the lower bound, as the process is not an exact science. And most countries will wish to hold a "comfort margin" above the minimum they identify. But it is important to realise that, except in rare cases, the authorities are unlikely to do best by accumulating reserves without limit.

2.4 The role of gold

Gold has traditionally formed part of a country's foreign exchange reserves; in the past, for many countries it was the major or even the only asset in the reserves. The traditional reasons for holding gold have included:

- the "war chest" argument – gold is seen as the ultimate asset to hold in an emergency and in the past has often appreciated in value in times of financial instability or uncertainty;
- the ultimate store of value, inflation hedge and medium of exchanges – gold has traditionally kept its value against inflation and has always been accepted as a medium of exchange between countries;
- no default risk – gold is "nobody's liability" and so cannot be frozen, repudiated or defaulted on;
- gold's historical role in the international monetary system as the ultimate backing for domestic paper money.

More recently, the role of gold as an official reserve asset has increasingly been queried. Gold has suffered from very poor price performance over past decade or two, and is no longer at the centre of the international monetary system. Moreover there are few signs that either of these failings are about to be rectified – the poor price performance is seen as being related to the "central bank overhang" (ie the official holdings of gold which the market expects or fears will be sold if the price ever picks up), and the international monetary system does not look as if it is about to return to a metallic standard.

Meanwhile gold is expensive to store and keep secure, and inconvenient to trade, especially if transactions involve a change of storage location. Many countries have therefore concluded that gold should play a reduced or even no role in their reserves management operation, a conclusion that the increased pressure on central banks to improve returns on reserves has only exacerbated.

Nevertheless a case can be made for preserving some role for gold in a country's reserves management strategy. The traditional view of gold as the ultimate asset still carries weight, and gold also provides an excellent diversification for currency assets; over the very long run there is a significant negative correlation between gold and other assets and a portfolio containing gold will show lower volatility over several business cycles. Moreover central banks can increasingly manage their gold holdings to enhance returns through gold lending, gold swaps, collateralised borrowing, and so on. So whereas few countries will find that gold

has a dominant role in their optimum reserves management strategy, an element of gold holding at the strategic level should not be ruled out completely. Further, gold's price weakness since 1980 does not imply that it will never return to favour; the cycle for gold prices tends to be a very long one and in the 1970s gold as an asset performed very well.

2.5 Delegation and control

The correct use of delegation, while maintaining overall responsibility and control, is one of the fundamental elements of effective management. This is particularly true in reserves management, where the trading and analysis involved in active portfolio management is too time-consuming, complex and detailed for senior management to undertake it themselves, but the sums of money and the risks of loss are too large to be left entirely to junior staff.

Instead senior management must delegate the day-to-day trading decisions, while retaining control over the overall strategy and large scale positions. This necessitates a formal structure of decision-making, in which each level of management knows what they are responsible for and within which parameters or limits they are free to move; and a formal monitoring system, through which senior management can ensure that more junior levels are not exceeding the authority that they have been delegated. Given a system of controls to ensure that delegated power is not abused, there is no reason why junior staff should not be given relatively wide power, certainly in comparison with their peers elsewhere in the typical central bank.

In most reserves management operations, there will be three basic levels of management. The top level consists of those who are ultimately responsible for the reserves. This level will usually set the overall objectives and strategy of the reserves management operation. Typical issues that this senior level of management will be concerned with are the size and broad currency split of the reserves, the overall interest rate exposure position, the credit risks and credit limits policy, whether or not to borrow and if so in which markets, legal questions such as whether the central bank has the *vires* (powers) to undertake certain operations, etc.

The second level of management is the direct line management of the reserves management team. This level is responsible for interpreting and implementing the strategy agreed at the higher level (which may only be drawn in the broadest terms) and reporting back to the higher level on results. Typically this will involve decisions on which markets and which instruments to use, on the major positions to be taken, on the allocation of funds between the portfolios, on how much latitude to allow portfolio managers in implementing management positions, and

on the form of the control and reporting procedures used. The line management will also typically be responsible for the general staffing and operation of the reserves management team within the agreed budget.

Finally there are the portfolio managers, who will be responsible for carrying out the instructions of their line management and providing the day-to-day management of the asset portfolios. This is done by active portfolio management, ie direct investment operations with the market within agreed guidelines of flexibility and authority. It is a feature of this devolved delegated approach that it is typically only the portfolio manager level that has direct contact with market counterparties.

For this hierarchical approach to be effective, it is important that each level is clear what it is responsible for, and also that senior levels of management avoid seeking to reclaim for themselves decisions that have been delegated to a lower level. This is best achieved through a formal benchmark process, and this is described in detail in chapter 3.

The process of delegation and control should be completed by a regular review and reporting schedule (this is examined in more detail in chapter 7). This will enable senior management to retain the overall control of the reserves management process. If the structure is designed properly, it will also identify which part of the overall return stems from which decision, thus enabling all levels to see directly the results of their own decisions. This direct and highly visible connection between decisions taken and profits earned is both essential feedback in analysing performance, and also an excellent motivator for junior reserves management staff. If, on the other hand, senior management retains direct control of investment decisions, junior staff will act merely as order-processors, with little incentive to add value to the reserves management operation. As well as being likely to result in missed profit opportunities, this is demotivating for the junior staff involved and fails to develop the next generation of senior managers.

3 The Benchmark process

3.1 Description of the benchmark process

Section 2.5 above introduced the concept of delegation, and explained the importance in separating the duties and responsibilities of the various levels of management in reserves management. The most commonly used method by which decisions from one level are passed down to the level below, and by which results of decisions are calculated and passed back up the management chain, is the

Benchmark process. A benchmark is a notional or imaginary portfolio constructed to provide a yardstick or baseline against which the return on an actively-managed portfolio can be measured. In most cases the composition of the benchmark will be a senior management decision, and it will be set up to conform to a given size, credit quality and average maturity. Benchmarking provides a base or neutral position from which a manager can adopt his own position according to his judgment and market views, and acts as a comparison point against which to record the results of those decisions.

There are three fundamental properties of a benchmark-based decision process. Firstly, the decisions of one layer of management form the benchmark for the next layer down. For example, the senior management of the central bank may agree a core strategy of keeping 50% of the reserves in US $ and 50% in euro. This then becomes the base or core position around which the line management of the reserves management team operates. They in turn decide such matters as whether to hold a small long or short in $ versus euro against the core strategy. Their decisions on these points will then form the base positions from which the active portfolio management is run.

Secondly, it must be possible physically to match one's benchmark. This is true whatever level of management is being considered. A manager is only responsible for the amount by which his own position deviates from his benchmark. It follows that if he has no firm views on an element of the portfolio, he will wish not to hold a position there; and this is achieved by matching his benchmark. For example, the line management may have no views on, say, the future direction of currencies. With no views, there is no point in holding a position (as to do so is to run a needless risk). The line management will therefore match the senior management's currency position exactly.

Finally, the results attributed to a manager must relate only to his position relative to his benchmark. A manager, at whatever level, should not be responsible for a decision that was not his to make. This is elaborated in the example in box 1 overleaf.

Box 1: Taking a position against the benchmark

A central bank has a portfolio of US Treasury 10-year notes. The reserves management line management decides to hold $100 mn in the portfolio. This is (a) the line management's position and (b) forms the benchmark for the portfolio manager. If he has no market view he will also hold $100 mn of notes.

The portfolio manager is however negative on the market and decides run a short. He does this by holding only $95 mn. His own position, relative to his benchmark, is now –$5 mn. Although the central bank as a whole is long the market, the portfolio manager himself is short.

Now let us assume that the US 10-year note falls by $1 in the market. The actual portfolio therefore loses $950,000. But the benchmark portfolio, if it had been held exactly, would have lost $1,000,000. The overall actual return is therefore split as follows:

> Loss on benchmark position (attributed to line management's decision to hold $100 mn of notes in a falling market) = $1,000,000
>
> Profit on active management position (attributed to the portfolio manager because of his decision to be short $5 mn in a falling market) = $50,000
>
> Overall loss on portfolio = $950,000

Both line management and portfolio manager have been credited with the return that arose from their decision. In particular, the portfolio manager was not responsible for the decision to hold 10-year treasury notes and is not therefore responsible for the loss recorded by doing so. Another way of looking at the overall result is that the portfolio manager's decision has saved the central bank from losing as much as it would otherwise have done.

In general, the overall return on the reserves is the sum of the returns on the individual levels of decision. In this case, the overall return of –$950,000 is the sum of the line management's loss and the active management profit.

3.2 Setting a long-term top-level benchmark

One subject for discussion is whether the top level in the decision process should themselves have a benchmark. Because they have no layer above them to give them a neutral position against which to operate, it can be argued that the distinction between the reserves' neutral position and the strategy decided at the top level is meaningless: if senior management choose to move the reserves more heavily into, say, the US $ then that automatically becomes the new neutral position for the reserves. And again, because there is no-one else to allocate responsibility to for returns, once the results of the layers beneath have been derived and removed from the overall returns, then the remaining unallocated return must by definition belong to the top level and stem from the neutral position.

Nevertheless, there is a case for looking beyond even the senior management's position to an ultimately neutral position. This will take the form of a long-term agreed strategy: it is likely to remain unchanged for years at a time, and only be reviewed in the light of a fundamental change in a country's overall situation, or of world markets as a whole (for example, the change from centrally planned to market-based economies as experienced by the ex-communist countries, or the change from fixed to floating exchange rates, or currency union in Europe). The main functions of this long-term neutral position are to prompt a fundamental examination of the strategy for the reserves, to give the senior management a consensus position on which to base their current strategy, and to prompt discussion if they decide to depart from it; they should usually expect to hold it, and any divergence from it should need to be justified. It will usually be drawn in the broadest terms only – for example, an agreed strategy to be overall flat market exposure, or in which proportions between the major currency blocks the reserves should be held.

3.3 Operational issues in benchmark setting

In establishing a benchmark process, senior management will need to agree on a number of operational issues. These include how frequently the benchmark is changed, what the investment horizon is for the benchmark's positions, whether the benchmark is a "buy and hold" portfolio or a trading portfolio, and so on.

The main theme behind these issues is the need to establish a clear dividing line between trades done by the benchmark and trading by the active portfolio managers. If the benchmark is too active it risks dominating the active trading: portfolio managers will find that all the potentially profitable positions have been taken at the level above them and they will not have enough freedom or opportunities to add value. This is a particular danger if the benchmark seeks to take positions in the expectation of reversing them: in this case the benchmark is at risk of being barely distinguishable from a high-level active manager.

One useful test in establishing this divide between what is a benchmark trade and what is active management is to distinguish between portfolio improvement and positions involving risk. We recall that any portfolio has a given level of risk and a given level of (expected) return. Now any trade which either (a) increases the expected return without increasing the overall risk on the portfolio, or (b) decreases the overall risk on the portfolio without reducing the expected return, will produce a resulting portfolio which is clearly "better" than the original one, in that its expected return is at least as great as the original if not greater, and its risk is no more than that of the original and potentially less. Such trades can therefore be considered "portfolio improvement trades", and are very suitable for the

benchmark level: in particular, they do not rely on a subsequent reversal at favourable terms to deliver positive returns.

In contrast to portfolio improvement trades, one can also construct trades which increase expected return but also increase risk. Such trades seek to use risk to generate excess returns, and they usually do rely on a subsequent reversal at favourable terms to deliver positive returns. These are not suited to the benchmark level, not least because they require ongoing monitoring and a further decision about the reversal level. These trades are therefore suitable for the active or portfolio management level, and are described in chapter 5.

3.4 Instrument issues in benchmark setting

Another important decision is which instruments the benchmark should contain. For example, should the benchmark be limited to government bonds, or should it also contain spread product. There is a balance to be struck here between making a benchmark so optimal and inclusive that active managers can only add extra return at unacceptable risk, and a benchmark that gives portfolio managers too many easy plays.

Theory (and section 3.3 above) would suggest that management should aim to make the benchmark relatively inclusive, so that it captures most or all "natural" profits. For example, if the reserves are permitted to hold spread product such as eurobonds, and the benchmark is limited entirely to government bonds, then there is a natural play for the portfolio managers from government bonds into eurobonds, and on balance this should be highly profitable. In this case, there is an argument for reconfiguring the benchmark to contain a holding of eurobonds itself.

In practice it may be better to err on the side of simplicity, both for ease of understanding the benchmark and for psychological reasons. It can be counter-productive to make the benchmark too optimal and too difficult to outperform; the portfolio managers will be demotivated by their apparent failure to add value and senior management (and the public) will increasingly query the value of the reserves management operation. Active management needs to be <u>seen</u> to be successful, by management, staff and public alike!

3.5 Positional issues in benchmark setting

This covers the two major decisions of currency allocation for the benchmark and neutral duration. These two questions differ from the operational and instrument questions, which are mainly structural and decided once. By contrast, positional decisions should be reviewed and may be changed at regular intervals. Moreover,

the decisions can be further split into fundamental high level decisions and more opportunistic trading decisions.

Of the two, the currency allocation will be a long-term decision, only changed every several years, while the neutral duration decision may be considered more frequently. The question of the best fundamental currency allocation obviously depends on a number of factors, some of which were touched upon in chapters 1 and 2. Central banks managing reserves against liabilities (see section 1.4) will have a natural currency allocation given by those liabilities to base the asset decision on. For others, the pattern of the country's international trade, or the main intervention currency, or even the *numeraire* for the reserves (eg are they reported in dollars or euros), will all guide the choice. But whatever currency allocation is chosen will probably not be changed much thereafter except at the margin, not least because central banks as a class have a vested interest in the stability of currency markets and are therefore more constrained than other market participants in the degree to which it is appropriate for them to take aggressive currency positions.

In contrast to this, the duration position is one which a central bank can properly assess and change more frequently. Especially in liquid markets such as the major government bond markets, movements from one part of the yield curve to another are usually not difficult to accomplish and not destabilising to the market if done with due care. In most official reserves management operations, therefore, the majority of benchmark decisions will usually be with respect to the preferred duration rather than currency trading. (The Appendix considers the optimum duration of official reserves in more technical detail).

Although changes in the benchmark's positions are for line management or senior management to decide, there is much sense in involving the portfolio managers in the discussion process before any decision. They will have the immediate contact with the market and the latest analysis, and they will also be able to advise senior management on the practical execution of any benchmark trades agreed upon. One standard arrangement for this is for a regular Investment Committee, chaired by senior management but with input from line management and the portfolio managers. Such a committee should not meet too frequently – a monthly meeting may be best – or it risks taking up too much of senior management's time and blurring the distinction between benchmark and active trading. But used correctly it can be an excellent way of keeping higher levels of management informed, and can add considerable value and discipline to the reserves management process.

As a final observation, management should resist making small changes to the benchmark. As a rule of thumb, the standard benchmark change or trade should be

an order of magnitude larger than the typical active management trade. This is for two reasons. Firstly, it reduces the temptation for senior management to fine-tune the benchmark and maintains the clear distinction between benchmark and active trading. Secondly, if the benchmark trades are the same order of magnitude as the active portfolio manager's own trades, he can negate management's intentions by taking an equal and opposite position for himself. This leads to confusion.

3.6 Maintaining the benchmark

So far this chapter has considered discrete changes in the benchmark to reflect management position-taking. There are two other circumstances in which a benchmark can change. The first is the passage of time. This will age the notional portfolio that constitutes the benchmark, and some formal replication rule will be necessary if management wish to maintain its average maturity. Secondly, the size of the reserves could change. This will also need a formal response so that the benchmark reflects the new size of the reserves.

These benchmark changes should be achieved by "benchmark trades". These are notional trades in the securities that make up the benchmark, but conducted in real securities that actually exist and at market prices. They are treated exactly as if they were real trades in a real portfolio, thus continuing the principle that a benchmark portfolio is handled as if it was a real portfolio in all respects wherever possible. (Where it is not possible to find a real bid or offer in the real world for some of these trades, eg where no market price exists, a sensible fair price must be used). Because the benchmark trades are in real securities and at market prices, the portfolio manager is able, if he so chooses, to "match the benchmark", thus precisely maintaining his current position vis-à-vis his benchmark.

Obviously any more radical change in the policy environment facing the central bank may require a more fundamental reassessment of the benchmark for the reserves. If possible, any subsequent changes should also be achieved through benchmark trades, but this is not always possible.

3.7 Alternatives to benchmarking

The complexity of the benchmark process, and the need to construct a bespoke benchmark for one's own particular circumstances, has led to a number of less complicated alternatives being considered for use in official reserves management. The most common three are indexing, comparison to external managers and targeting a fixed rate.

Indexing is the most common alternative. There is a wide range of public indices available for a central bank to match its portfolio to, with many of the

investment houses producing them and most available on the wire services or electronically. This is essential if detailed analysis is to be done of positions relative to the index. The main advantages of indices are:

- transparency – the index is publicly available and there is no doubt about its properties such as its duration, composition or value;
- external measurement – the index returns are calculated by the index provider and cannot be disputed;
- simplicity of use – using an index avoids complicated benchmark calculations.

Against this there are two major disadvantages with indices. First, they cannot reflect a central bank's individual circumstances. Indices are of necessity general, and may contain instruments the central bank does not want to (or is not permitted to) buy. Or they may not match the desired currency or duration position that the central bank wishes to adopt. Although indices can be tailored to overcome these difficulties, much of the advantages of simplicity and transparency are lost in doing so.

Second, indices can be too comprehensive and lead to too much trading. Some indices contain hundreds if not thousands of securities and are rebalanced with great frequency. A portfolio manager trying to match such an index is faced with the choice of multiple holdings and trades, which may not be efficient, or holding a subset of the index, which introduces the risk of different performance from the index (known as "tracking error"). Often the only solution to this dilemma is a compromise between the two which is not entirely satisfactory on either count.

An alternative approach which many central banks consider is to compare the internally managed portfolios to a portfolio given to an external manager. The main advantage of this method is that it ensures that the comparator for the internal portfolios is realistic – it is itself an actively managed portfolio and faces all the same opportunities in the market to add value. But the approach has a number of disadvantages:

- the comparison will only be fair if the external manager has exactly the same opportunities (investment instruments etc) and faces exactly the same constraints and limits as the central bank itself;
- the comparison will reflect the performance of the external manager as much as the central bank's;

- any analysis of the central bank's own performance will therefore need considerable amounts of information on the performance of the external manager to understand the reasons for the relative performance;

- the process does not help establish what the external manager's benchmark should be;

- the process cannot be used by central banks which do not want to (or are not allowed to) entrust money to external managers.

The issue of whether or not to employ external managers in official reserves management is explored in more detail in chapter 8.

A final method of assessing the performance of the reserves management operation is to compare it to an absolute target. For example, the target could be for a minimum return of say 5%. This has the advantage of simplicity. But it has many disadvantages. The main one is that it takes no account of general market conditions – if market rates are high, or if the trend of prices is favourable, the target is too easy to beat, and so does not set a demanding test of performance, while if rates are low, the target is very difficult, and can tempt managers to increase risk too much to match it. Moreover, such a target gives no opportunity for senior management to express a view about the overall direction they want the reserves management operation to pursue.

Because of these major disadvantages, few central banks will rely exclusively on absolute targeting for measuring their reserves management. However, more for psychological reasons than for any more financial ones, it is less uncommon for a central bank to include an absolute target as one of the objectives for their reserves management. For example, a common one is that the overall absolute return on the reserves should not be negative over the year. This can have merit if it prevents a public loss of confidence in the reserves management process which a net negative result might produce.

4 Liquidity management

4.1 Definition of liquidity management

It is important in discussing the subject of liquidity in reserves management to distinguish between liquidity management and cash management. There are many demands for cash that the reserves management operation has to meet as part of the

ordinary work of the reserves managers; these include the settlement of bond market transactions, debt servicing payments, minor foreign currency expenditure by the government, and so on. But in most cases these payments are routine and predictable, often a long way in advance, and they do not involve any major policy decisions or, usually, any large scale use of cash. The management of such payments is properly met by forward cash management planning or account balance maintenance (and is not the subject of this chapter).

By contrast, there are some situations where a central bank faces a call for large amounts of cash, unexpectedly and at short notice, and possibly against a background of unstable markets. This calls for a different set of skills, and a different set of instruments. The most obvious example of such a situation is when the central bank is conducting intervention to defend an exchange rate, and specifically when it is trying to stop the domestic currency falling, so that it is selling foreign currency to support the domestic currency. Such operations cannot typically be satisfied by standard cash management, and moreover it would be wasteful to keep enough cash to finance a crisis permanently "on hand". Instead, central banks have to find another method of meeting such demands for cash.

To distinguish it from cash management this operation is usually termed "liquidity management". One can define liquidity management as "the ability to provide large amounts of cash out of the reserves at short notice". The rest of this chapter will be based on this definition, and discusses how this is incorporated into the reserves management operation. Since liquidity is usually only available at a cost (because more liquid assets are also usually lower-yielding), liquidity management largely consists of a trade-off between the amount of liquidity a central bank decides it needs to hold and the cost of doing so. Successful liquidity management can be defined as "the ability to provide large amounts of cash out of the reserves at short notice and at acceptable cost".

4.2 The decision to hold liquidity

Any discussion of the need for liquidity in a central bank reserves portfolio is largely shaped by the role that intervention plays in that central bank's management of its reserves. For those central banks that operate within a true floating exchange rate regime, intervention may play no role at all in their reserves management decisions. The central bank leaves determination of the exchange rate entirely to the market, so it has no need to buy or sell its own currency at all for policy reasons. Equally, both because it is usually politically unacceptable, and because it has no view on the "proper" level of the exchange rate, it is unlikely to want to intervene for profit-generating reasons. Such a central bank will tend to

manage the reserves with fairly low levels of cash on the whole, in effect keeping little more than working balances.

However, very few central banks have this totally detached view of what their country's exchange rate should be, and as discussed earlier (section 1.2) most will be operating in a policy environment that ranges from a dirty or controlled float through various degrees of formality to a full fixed rate regime. For these central banks, there is a non-zero chance that they will be called upon to provide large sums of cash at short notice out of the reserves.

The first and most important decision that needs to be taken is how much liquidity should be held. It is possible to argue that a central bank should be ready and able to use all the reserves for intervention if the need arises. If so, the reserves should be kept entirely in highly liquid assets. Indeed this was not uncommon in the past: in the 1980s, for example, intervention was usually done in the spot markets, and this led to a need for cash liquidity. This was usually funded by sales of securities, and in order to be able to liquidate large amounts of securities at short notice and at not too high a cost in bid-offer spreads, central banks tended to hold a large "war-chest" liquidity portfolio. The choice of assets and instruments for this portfolio was heavily constrained by the absence of a wide range of alternatives; in fact, liquidity portfolios were almost always predominantly US $ Treasury bills and other short term US $ money market instruments. These instruments were held almost regardless of their cost.

Recent developments in the markets have led to the existence of a much wider range of methods for central banks who wish to intervene, including forward FX and options, and a much wider range of funding methods, including repos and swaps. In addition, liquidity and market depth has increased in many of the second tier markets and securities, to the extent that it is no longer necessary for a central bank to be constrained to the traditional war-chest markets for its liquidity funding. As a result the liquidity debate has more recently focused increasingly on capping the level of liquidity in the reserves, given the trade-off between liquidity and return on assets. It has become more clear that holding a high proportion of highly liquid assets is no longer always the optimal policy, given changes both in the structure of government bond markets (led by diminishing supply, which has resulted in a growing premium for government debt and so a greater cost for holding such securities in the liquidity portfolio) and in the growing efficiency and depth of repo and forward markets.

As a result the decision on how much liquidity to hold, and in what form, has become a more complex one. It involves firstly an assessment of likely future intervention and future calls on the reserves. While the past can be some guide to

the future here, there is inevitably a considerable degree of uncertainty surrounding the issue, and the exercise is thus primarily a problem in probability estimation. This fact, plus the fact that the cost of having too little cash when it is needed is far greater than the cost of having too much, will tend to result in most central banks erring heavily on the side of caution.

Secondly, the central bank also needs to take a view on how quickly the liquidity will be needed. Will it all be needed for spot settlement? Or will it be possible to build the liquidity portfolio to provide only a certain proportion of the cash for spot value (ie 2-day value, since the FX markets operate on a 2 business day settlement cycle), with the rest available after 3, 4, 5 days and so on? Again, these are decisions that are taken against a background of considerable uncertainty and with sound reasons for building in a good margin for error.

4.3 The cost of liquidity

It has already been stated that liquidity usually comes at a price. This is because in normal markets and comparing assets of like credit quality, the more liquid an asset is the more expensive (ie lower yielding) it is, as holders are prepared to pay a premium for the liquidity. But this is not the only cost of liquidity that needs to be borne in mind.

For assets that are held with a view to selling them to raise cash, the central bank will need to factor in the liquidation or selling costs. The wider the "spread" between buying and selling price, the larger the cost of selling the asset. Moreover, the estimation of the liquidation costs needs to be done for a number of possible market scenarios; for example calm orderly markets, disturbed or volatile markets, and crisis markets. Although a given bond might trade on a narrow or tight spread in calm markets, in crisis conditions a forced seller may well have to accept a much larger discount.

For this reason central banks are increasingly turning to the repo market as their preferred source of cash liquidity. If a bond is sold outright, the discount on the price obtained compared to the "fair market" price is lost for good. But if a bond is repoed, ultimate ownership stays with the central bank, and the reserves avoid the loss that comes from a forced sale at a poor price. In addition, the central bank avoids the risk that it will be forced to sell "at the bottom of the market", ie at a time when yields are abnormally high and so prices are depressed.

Nevertheless, using the repo markets to raise cash is not without its costs and drawbacks. On the one hand, securities can only be repoed for their current (cash) value, so that in periods where prices are depressed the central bank will find that the amount of cash it can raise using the reserves as collateral is correspondingly

reduced. As well as this, though, counterparties will require a haircut (ie, will deliver less than full value in cash against the repoed securities) to protect their exposure, and as markets become more volatile (and also in some cases as the creditworthiness of the borrower is seen to be under pressure) this haircut will grow. And finally, repoing securities can result in more work administratively, especially if the repos are "rolled" (ie the loans renewed on their expiry).

Despite all these extra costs and complications, the advantages of repo as a way of raising cash at short notice are generally seen to outweigh the disadvantages. For those central banks whose investment guidelines permit repo and whose settlement operation can handle it, therefore, repo has increasingly become the preferred route for liquidity management.

4.4 Designing a liquidity strategy

This section considers the problem of deciding how liquidity should be held, and in what asset classes. The discussion is more technical in nature than much of the rest of this handbook and may be omitted by the general reader.

The problem of designing a liquidity strategy is essentially one of constrained optimisation. Following the decision by senior management on how much to hold in the liquidity portfolio overall, the task is to maximise the return on the portfolio given the probability distribution of liquidity demands and the costs associated with liquidation. The constraint is the requirement to be able to supply specified minimum amounts of cash at notice periods ranging from 0 days upwards.

As a first step, the permitted types of asset (bonds, bills, assets for repo, etc) should be classified into *liquidity classes* according to the minimum number of days' notice required to raise cash against them. For example, cash can be raised for same day value through repoing US treasuries, whereas it will take at least 4 days to raise cash using Yen T-bills. The problem then falls into two parts: first, a decision on how much to invest in each class, and second, a decision over which assets to hold within each class. (Note that an asset may fall into different liquidity classes depending on whether the central bank aims to raise cash from it via an outright sale or via repo. But it cannot of course be used for both).

The amount to hold in each liquidity class is determined directly by the minimum liquidity constraint mentioned above. This will be a straightforward read-across. More interesting is the second question, and this will require an assessment of the trade-off between expected returns and the cost of raising cash using that asset. This is where the optimisation part of the process takes place.

For the resulting liquidity portfolio to be useful in all circumstances, the expected returns and expected liquidation costs for the various asset classes need to be assessed under various market conditions; the optimum portfolio under calm market conditions may not have acceptable characteristics under volatile or crisis conditions. The resulting liquidity portfolio that is finally chosen will probably be a compromise between the portfolio that yields the most in normal situations, and the one that is least badly affected by crisis market conditions, and the precise nature of the compromise will be driven by such factors as how risk-averse the central bank is. Greater caution would usually be advisable in circumstances where the starting assumptions contain sizeable uncertainties.

5 Active management

5.1 The rationale for active management

Active management is the term usually given to the operation of the most junior level of reserves management staff. These are usually the portfolio managers, and the main distinguishing feature of their work is that, unlike the higher levels whose decisions affect the notional benchmark portfolios, they are dealing in real securities and real portfolios directly with the market. The second distinguishing feature is that, with all the strategic and policy decisions taken at higher levels, the portfolio managers can concentrate on trading to generate excess return.

The legitimacy of a central bank trading its reserves portfolios for profit has been discussed in section 2.2 above, and it is generally accepted that central banks are fully entitled to so invest their reserves as to maximise the gain they can make on them. This is not to say that central banks have *carte blanche* to deal and seek profits without restraint; a central bank should always manage its reserves in such a way that it does not destabilise markets, take advantage of privileged information or hinder another central bank's operations or objectives. But this still leaves considerable freedom of manoeuvre, especially for smaller central banks whose operations are not large enough adversely to affect markets or prices.

The main reason for active management is that it can be profitable, and these profits can offset the costs of running the reserves management operation. Indeed, for some central banks, the profits on the reserves can be considerable. But there are two other reasons for senior management to allow their portfolio managers actively to seek profit. Firstly, it is an excellent way of motivating junior staff: the measure of profits earned is a real and highly visible indicator of success, and can also show senior management which of their staff have a "feel" for the market. A portfolio manager who is making correct market decisions in his or her portfolio

trading will generate profits; this gives him or her an immediate confidence boost and management a clear indicator of the sound basis of the operation. Secondly, active management helps keep the portfolio managers closely involved in the market. This will both keep their trading skills sharp and fresh, and make them a valued and hopefully respected counterparty. If a central bank only enters the market irregularly and occasionally, it may find that its traders are unfamiliar with the market when a crisis forces the central bank to act.

A final bonus from an active style of portfolio management, and the close involvement with the market that this will entail, is that the portfolio managers should become adept at spotting small signals in the market and will become a valuable surveillance asset for the central bank as a whole. Often a financial crisis first surfaces in the markets (perhaps through a rumour spreading among the dealer community or an unusual price movement) and a central bank whose reserves managers are in constant touch with the market and their counterparties will be well placed to learn about such events and developments early.

5.2 The decision-making process

Active management involves taking on risk in order to add excess returns. Risk is therefore an integral and essential part of active management. It should not be avoided, but controlled and used. The key to successful active management is deciding when and how much to take risks.

There are broadly speaking two types of active management. Outright trading (ie taking outright positions long or short of one's benchmark) tends to lead to a few large positions. If successful it can generate large returns but they are liable to be highly volatile and the central bank adopting this approach must be prepared to accept sizeable losses as well. Relative value or technical trading, on the other hand, seeks to exploit situations where one asset is temporarily cheap compared to similar assets. This tends to lead to many "small risk, small return" trades as the portfolio managers exploit imperfections in the market, and less volatile returns. For most central banks, this latter style will tend to dominate, but there will also be room in all but the most risk-averse central banks for an element of outright trading.

Whichever style of trading is adopted, an important element of successful active management is a structured decision-making procedure. One effective such procedure is the "Four Ps" method:

- Process information
- Predict the future

- Position the portfolio
- Profit

The first element of this method is to process the information already in the market. The market contains an enormous amount of information, and no investment manager can expect to manage a portfolio successfully if this information is not made use of. Without this base, the wrong investment decisions will be taken even if the rest of the analysis is correct. One important element of this is to know which markets should be studied. It is seldom enough to study merely the markets which one is directly involved in, as other markets which the central bank does not invest in may influence those it does. For example, even an investor restricted entirely to US fixed income securities will need to observe movements in the US equity market: because other investors can and do invest in both markets and switch between the two, movements in the equity market can influence the bond market.

Secondly, the information gleaned from the market must be used to predict the future. It is no surprise to say that this is easier said than done! But it is essential that for every trade that the portfolio managers put on there is a sound rationale, and that rationale should always include a prediction of the future price movement of the asset bought or sold. Without this, the positions taken by the portfolio managers cannot be held with any confidence and any profits that are generated will owe more to luck than skilled judgment.

Modern computer systems and wire service databases (eg Bloomberg) contain huge amounts of analysis and data on the past. However, analysis of the past will not automatically produce profitable trades, if the relationship between the past and the present is not properly understood. The past is only a guide to the future, and the more circumstances are changing or have changed, the less reliable the guide will be. Portfolio managers need to understand the present, not merely rely on the past repeating itself.

Having tried to predict the future movement of the markets, the portfolio manager should position the portfolio accordingly. This is another area where inexperienced portfolio managers often make mistakes. On the most basic level, a portfolio manager who does not know what positions he or she is running cannot manage them with confidence or any long term success. But while positions which depend on a single event occurring are easy to monitor, analyse and understand, positions with multiple plays embedded in them are more complex and can confound even quite experienced portfolio managers, causing unexpected losses.

Box 2: Examples of positions with multiple embedded plays

A: A position with yield curve and duration elements

A portfolio manager who is bearish on the market sells $10mn 5 years and buys $10mn 2 years. Although this looks like a simple shortening trade it combines both a duration (market direction) play and a yield curve play between the 5-year sector and the 2-year sector.

As a result **the play can lose money even if the bearish call is correct,** for example if 2 year bonds rise in yield by much more than 5 year bonds (a bear flattening, a typical response to an unexpected tightening by the Federal Reserve).

B: A cross market position with multiple elements

A portfolio manager believes that the spread between euro bonds and US treasuries will widen, and seeks to profit by selling 5 year Treasuries and buying 5 year OBLs.

This trade contains a cross market spread trade as the portfolio manager intends. But, depending on how the FX position is managed, it also contains either a currency trade (if the $ proceeds from the sale of the Treasury position are used to buy euro to buy the euro position) or, if the portfolio manager does not also undertake the FX trade, two yield curve trades (from 5 years to cash in $ and from cash to 5 years in euro).

As a result, what seems on the surface like a simple spread trade between two bonds also depends on some or all of: FX rates, $ cash rates, euro cash rates and the slope of the two yield curves. **There are many ways in which this trade can lose money** even if the portfolio manager's expectations for the spread element of the trade prove correct.

Generating active management profits is not a matter of luck. Nor does it rely on "a better crystal ball" – ie some superior forecasting techniques. Instead it requires methodical and disciplined processes, the maintenance of good relationships and detailed analysis of the market. Successful portfolio management needs a combination of understanding the market and understanding the positions in one's portfolio, and portfolio managers who do not have these two understandings may make some profits for a while but will not make sustained profits.

5.3 Risk measurement and monitoring

An important difference between active management and other parts of reserves management such as benchmark setting or liquidity management is the attitude to risk. Most central banks will adopt a relatively risk-averse approach to their reserves management operation, and risk minimisation will usually play a major role in such elements as the choice of neutral benchmark positions, the regime for controlling credit risks, and so on. As observed above in section 3.3, however,

active management is materially different, in that it involves the deliberate taking on of extra risk in the pursuit of extra return. A central bank's attitude to risk is therefore an essential element of its decision on how much active management to undertake.

Although each central bank will need to establish its risk tolerance for itself, there is a well-recognised pattern to the evolution of attitudes to risk. In the very early stages of reserves management, risk is simply ignored, and is therefore not an issue. Few central banks are content to stay at this stage however, and the next step is usually therefore for the reserves managers to calculate the risks being run. There are a number of issues here, and some of them are explored below, but however the risks are calculated, the net result is a measurement that senior management can use to determine whether the positions being run are suitable given the central bank's overall attitude to risk.

In nearly every case where this is done the "knee-jerk reaction" is a degree of surprise at the risks being run and a strong desire from senior management to reduce them! However, this too is a temporary state and in mature reserves management operations it gives way to the realisation that proper investment management does not shun risk but uses it in a controlled way to generate returns. The main question facing senior management is then the setting of appropriate numerical limits (ie, setting an upper bound on the amount of risk being run) to be commensurate with management's risk appetite.

A rather different question is what kind of risk measurement the central bank should adopt. This will depend on a number of factors, including the style of trading the reserves managers do, the instruments that the reserves will be invested in, the degree of sophistication of the IT systems, and so on. For a central bank whose reserves management operation is characterised by infrequent deals only, and limited to simple instruments such as straight fixed income bonds, then there is little need for a highly complicated risk management structure and much advantage to be gained from simplicity: the simpler the risk system the less likely it is to be misunderstood by portfolio manages and senior management. However, a more active central bank which includes more complex instruments such as derivatives in its reserves management operation will wish to consider more sophisticated measures of risk. Three of the main questions a central bank will need to consider are:

- the handling of complex positions, eg cross-market or cross-currency;
- the handling of non-linear risk;
- the frequency of risk measurement and analysis.

Single position risk, often called outright risk (eg a position long or short a holding of bonds) is comparatively simple to measure. Management can either set an absolute nominal limit for deviations from the benchmark (for example "no holding to be more than ±$10 mn from the benchmark") or, with slightly more sophistication, employ a measure which recognises that longer bonds tend to move more in price (ie "be more volatile") for a given change in yield levels. Two such measures are delta (duration) and PV01. PV01 ("the price value of an 01") measures the amount by which a holding will change in value for each 1 basis point change in yield, and can be used to compare positions held in different bonds. For example, a holding of $20 mn 4 year bonds and a holding of $10 mn 10 year bonds carry equal position risk (ie, have the same PV01 measure) despite the former being twice as large in nominal terms.

This is the traditional approach to risk management for professionally managed portfolios. It is built around an analysis of the portfolio's current holdings or positions; the rationale for this is that the investor cannot predict what might happen to his portfolio, ie where his portfolio is going, unless he first knows where it is now. Because of the inherent relative stability and predictability of fixed income markets, as compared for example with equity, commodity or property markets, knowledge of the present carries with it more certainty about the immediate future than in other more volatile markets, and a wide range of position-based measures of risk such as those mentioned above were therefore developed for fixed income portfolios.

However, these measures suffer from a number of drawbacks and limitations. Firstly, they are all static, whereas fund management takes place in a moving environment. To a certain extent, this can be overcome with simulations and what-if analysis, but the quality of the information obtained from such exercises is very reliant on the quality of the forecasts fed into them, and in addition the assumption that the investor would hold his portfolio unchanged as various scenarios unwound around him has always been a little unrealistic.

Second, the risk measures are absolute, whereas markets move between calmer and more volatile phases. A position which is justifiable in calm markets might be too risky in more turbulent times. Traditional risk control methods, in which management for example lay down how much a portfolio may vary from a preset benchmark, struggle to respond adequately to varying market conditions, and the danger is that in order not to allow too much risk in difficult markets, management set limits so tight that no worthwhile positions can be taken even in more favourable conditions.

Third, traditional measures are too simplistic when assessing the risks in more complex portfolios. For example, a position short $20 mn 4 year bonds and long $10 mn 10 year bonds has no PV01 risk (ie it will not gain or lose value on a general change in the level of the yield curve). But it is nevertheless exposed to changes in the slope of the curve. And similarly, a position short $20 mn 4 year government bonds and long $20 mn 4 year bonds issued by another issuer (eg an agency) has no PV01 risk either, but it is not without risk as it is exposed to spread risk (ie the difference between yield levels on government bonds and on the other issuer's bonds).

Lastly, the traditional techniques struggle to handle newer instruments such as derivatives adequately. Even before the explosion of derivatives in the last 10 years or so, such basic and well-established investments as callable bonds (ie bonds with an embedded option) posed problems for the more traditional measures such as duration. A fall in general yield levels which results in a callable bond being more likely to be called will shorten the duration of any holding of that bond markedly.

For all these reasons, portfolio managers have increasingly looked for different tools to assess how risky the positions in their portfolios are. Until the rise of the options markets, the main counter to all the four failings above was intuition and experience. The volatility of markets was known to be important, but before options it was difficult to quantify rigorously. Similarly, correlations between markets could be calculated, but the tools to use such correlations in mathematical risk models were rudimentary at best.

A method which aims to meet these needs is "Value at Risk", or VaR. VaR is a different kind of risk measure in that it attempts to assign a probability to the riskiness or amount the position might lose. Given a probability p (usually 95% or 99%) and a time horizon t (eg 1 day or 5 days), then the statement that "a given position has VaR of $\$x$ mn" means that, with probability p, the position will not lose more than $\$x$ mn over the next t days. Such a statement is often of great value to senior management as it coincides closely with their need to control the level of potential losses. Moreover, VaR can be used with great effect to measure not just the riskiness of a position but of a whole portfolio, even one made up of different instruments (bonds, futures, etc) and currencies, and it is therefore extremely valuable for the more sophisticated reserves management operations in which cross-market and cross-currency plays are present.

Box 3: The pros and cons of VaR

A full analysis of the calculation and use of VaR is beyond this short handbook. The methodology is still comparatively new, and not without its critics. It relies heavily on past correlations between market sectors continuing to hold into the future in calculating the probability of future losses.

Those who favour the use of VaR point to its ability to reflect changing market circumstances (ie, to take into account when markets are calm and when they are volatile), its ability to combine all the positions in a portfolio into one risk measure and its relevance and ease of understanding for senior management, for whom the concept of "maximum amount we might lose" is especially valuable.

Against this, VaR is complicated to calculate (and so reliant on IT systems – portfolio managers cannot easily calculate VaR numbers themselves while considering a trade), dependent to a great extent on the parameters chosen (the probability *p* and the time period *t* mentioned above being but two of the factors involved), reliant on the assumption that market movements are normally distributed (there is evidence that in fact they have fat tails) and open to the criticism that it oversimplifies risk in distilling a whole portfolio into just one number. Finally, critics claim that VaR can lull senior management into a false sense of security. Even using 99% probabilities, the VaR figure is not an absolute upper bound on losses or a guarantee that greater losses will not occasionally be sustained. 99% represents 3 standard deviations; 4 and 5 standard deviation events can and do occur and losses can exceed the calculated VaR figures when they do.

The second issue a central bank needs to consider is the treatment of non-linear risk. Such risk arises from positions which change their nature as markets move; depending on the level of the market, therefore, the risk in the position may change sharply. For example, a position in futures will usually depend on the identity of the cheapest-to-deliver (CTD) bond. At a given level of the market the CTD bond may change. In these circumstances, the risk characteristics of the futures position will undergo a discrete and potentially quite large change. Similar discrete changes occur in options positions (eg as an option moves into or out of the money) and even, as mentioned above, in such "simple" instruments as callable bonds. More complicated financial structures have proved very difficult if not impossible to analyse with static portfolio statistics, largely because their response function to market moves (ie the way in which their price changes given a change in general market levels) is not only not linear but in many cases not even continuous or differentiable (in the mathematical sense).

For such positions, and despite the drawbacks mentioned above, the best tool for risk analysis remains scenario or "what-if" testing. This consists of recalculating the value of a portfolio under a given scenario; for example "all yields higher by 50 bp", or "all yield curves steeper". Management need to set the scenarios and

must use judgment as to how likely a given scenario might be and which scenarios to test, but the method is a powerful one and often the best way to handle positions whose nature changes as markets change.

Finally, central banks have to consider how often the risks in their positions need to be calculated and monitored. To trade with confidence that they will not breach limits, portfolio managers need to be able to assess the risks in a proposed trade (and the risks in their overall position were the trade to be done) before agreeing to the trade. The ideal is to have on-line measurement and monitoring, complete with a facility that allows portfolio managers to enter a proposed trade and examine the consequences of doing it in real time. In this way no trade should ever result in a limit being breached. However the IT support necessary to provide this may not be practical for some central banks, and, especially for those with less complex operations or who are not using e.g., VaR, it will usually be sufficient to have a daily position report (perhaps run overnight as a batch computer job) which the portfolio managers can trade from the next day.

5.4 Limits and controls

It is stating the obvious to say that the amount of risk that the active management operation can take on has to be subject to limits and controls. These limits and controls fall into three broad categories:

- controls which identify what can and what cannot be done (eg which markets, which currencies, which instruments the reserves managers may invest in);
- for operations, positions etc which are allowed, limits which put a numerical upper bound on how much can be done;
- for all allowed operations, details of the process portfolio managers must follow.

The decision about which markets, currencies and so on can be invested in is one for senior management, and will often be taken alongside other top-level decisions such as the make-up of the benchmark and the style of the reserves management operation overall. Once set the list of acceptable markets, instruments etc will probably not change very frequently. Many central banks publish a list of what they are permitted to do, both for wider public information and accountability and to assist counterparties in serving them. Adherence to this set of controls is usually very easy to monitor and indeed if the list has been shared with counterparties they will often query any attempt to deal in unauthorised instruments themselves, thus assisting in compliance.

Numerical limits on permitted operations are also essential, to stop the portfolio managers running excessive and potentially damaging risks. Their exact form will depend on the methods the central bank is using to quantify the risks in the portfolio positions, as described in the previous section, and the absolute size of the limits obviously depends on each central bank's own situation (overall size of reserves, risk appetite, etc).

Box 4: Different responses to limits

Portfolio managers react very differently to numerical limits and management should be aware of their responses when setting limits.

Some portfolio managers always use the maximum available to them under the limit. This sort of person always puts the full amount they are allowed to behind each decision. While this will maximise profits if they are right, it does not give room for increasing positions and is more likely to lead to breaches of limits by mistake.

Another common response to numerical limits is extreme caution. Portfolio managers often like to hold some of their limit in reserve, both so that they can add to a position and to ensure they do not breach a limit by mistake. Experience shows that this response is the more common of the two, and, perhaps surprisingly, the most common amount of usage of a limit seems to be around one-third. While this should make limit breaches very unlikely indeed, such practice risks not using the full freedom and risk tolerance that senior management would like to see used, and can mean lower returns as a result.

Finally, senior management must lay down the process that portfolio managers must follow. The list below is not exhaustive but issues here will include:

- the procedure for recording trades. For example, who has the authority to trade and to enter trades into the computer system, how soon should trades be entered into the system, how should limits be checked, whether competing prices should be obtained for each trade (see Box 5 below), and so on;

- whether or not to operate a "soft" limit system. A "soft limit" is an amount or level that is below the limit set by management. It is treated as a warning that a position is approaching the limit. For example, management may set a limit of 100, and then set a soft limit of 80, with the proviso that any positions which cross the soft limit are reported. In effect, management are saying to their portfolio managers "You are allowed to hold a position with risk over 80 but management will monitor it closely to ensure you do not breach the limit of 100";

- the procedure for handling limit breaches: how they are reported, to whom, and whether breaches should involve disciplinary measures;

- how to handle breaches that arise because of a movement in market rates. A position which is within limits when opened may subsequently move outside limits as a result of market movements. Typically the two responses that management can have to this are firstly to sanction the breach, or secondly to require that the position be brought once again within limits. There are advantages and disadvantages to both; the former results in positions which have more risk than management would normally allow, while the latter may result in positions being forcibly reduced or even closed at disadvantageous prices.

Box 5: Competition in prices

The issue of whether portfolio managers should be required always to obtain competing prices for every trade (ie, prices from a number of different sources to prove they have dealt "at the best terms") is often debated. In the past, when markets were often relatively opaque to central banks and the market level or price of a bond was not immediately clear, there was much merit in the practice. Today, with the much greater access to live market prices, there is less need, though for routine outright deals executed at the initiative of the central bank a case can still be made for putting a group of counterparties in competition, not least because the knowledge that they are from time to time in competition helps ensure they make a habit of offering keen pricing.

Two cases however where portfolio managers should not be required to obtain competing prices are firstly where they have a very large order to execute, and secondly where a trade is proposed to the central bank by a counterparty. In the first instance, asking more than one counterparty to price the deal merely advertises the central bank's position widely; for large positions this may make it more difficult to execute on fine terms. And in the second instance, to ask counterparty B to price up counterparty A's idea may at best be unproductive (B may not be positioned to do the deal) and at worst may discourage A from showing the idea in the first place.

In general therefore, an absolute requirement to show competing prices on all trades is usually best avoided.

6 Compliance and the Middle Office

6.1 Compliance

A central bank's reserves management operation is subject to various constraints. Some of these constraints are "hard" constraints, such as the number of staff the central bank has, the state of its IT systems and accounting systems, its ability

actually to settle in the back office the trades done in the front office, and so on. These are explored more in section 6.4 below. Other constraints are more "soft" constraints, such as the style of business, protecting the central bank's reputation for integrity, and operating within the law and within any contracts that have been signed. Compliance is mainly aimed at ensuring that adherence to all these soft constraints.

Compliance has four main functions:

- For the central bank itself, compliance to its own rules and the rules of the market will protect its reputation for proper conduct.

- For the owners of the assets (whether the central bank's own management or some other part of the authorities such as the Finance Ministry), compliance ensures that their assets are being managed safely and in accordance with their wishes. Compliance ensures that the rules, limits and controls that management set down are adhered to, and that the assets are available for use as and when required.

- For the central bank's counterparties, compliance provides the confidence that the central bank is acting legally and properly. Compliance ensures that the portfolio managers have the authority to trade and that the deals so done will not be struck down as illegal or exceeding the central bank's powers.

- For the central bank's reserves management staff, compliance gives them guidelines on the proper conduct of their business, and the security that providing they follow those guidelines they will be protected against recrimination and being asked to bear undue responsibilities in the event of problems.

There are five main elements of Compliance. These are Legal, Regulatory, Risk measurement, Credit risk control, and Ethics, or the general conduct of business.

With regard to Legal Compliance, central banks in general and their reserves management operations in particular, are not above the general law and must ensure that they obey it. This is particularly the case with any activities conducted outside the jurisdiction of the domestic legal system, as of course so much of reserves management is, because here the central bank cannot expect any special treatment from the courts in the event of a dispute. Central banks will also need to ensure that their business relations are concluded with proper contracts, and these should be so drafted as to protect any special rights the central bank has (for example sovereign immunity, freedom from domestic taxation and withholding

tax, etc). Finally, a very important part of Legal Compliance is to check that changes in the law do not invalidate existing arrangements.

Regulatory Compliance is similar to Legal Compliance, but is more concerned with the regulations of the markets that the central bank is operating in rather than the general law. Central banks are not exempt from regulations set by other authorities. Generally the more commercial their activities, the more they will be subject to regulations. On the other hand, a central bank may well be outside or exempt from regulations in its own country, whether set by itself or by other parts of the home authorities. However, before a central bank decides not to comply with domestic regulations, careful thought is required as to why they should be exempt.

The importance of Risk Measurement and Monitoring has been described in chapter 5 above. It is best practice to have risk measured and reported by someone other than the portfolio managers, to provide an independent check on their activities. Often this fits most neatly into a compliance function, and this is the subject of section 6.2 below. One important difference between risk controls and legal and regulatory constraints is that the risk limits are internally set constraints, and the consequences of a breach are therefore in the main internal rather than public.

Credit Risk controls, and in particular the decision on whether or not to deal with another bank or institution, are a special case of risk measurement. However, they merit special treatment because of the position central banks have in their domestic banking system. A decision not to accept a bank as a counterparty may well be misinterpreted by the market, who will wonder whether the central bank knows something about the soundness of the bank in question. It is therefore vital that the credit risk function is separate, and is seen to be separate, from any banking supervisory duties the central bank has. How separate is for each central bank to decide i.e., whether there is a complete ban on the passing of information from the supervisors to the reserves managers, or whether some information, say of a more general nature, can pass and if so at what level of management.

The final part of compliance, the Conduct of Business, is a nebulous subject, with no hard edges. Often counterparties will be more forgiving of a central bank than they might be of other market participants, and will be willing to do what a central bank asks of them even if it is unusual or verging on the unethical. It may seem therefore that a central bank has considerable latitude in how it chooses to conduct its reserves management business, and that it can “get away” with sharp practice. However this is a short-sighted approach. Central banks are generally very highly regarded for their ethical standards, and this is worth protecting. A central bank

that is caught bending ethical rules may find its reputation takes a long time to recover. Moreover, all central banks are the losers if any member of the family is a major transgressor of the unwritten rules of behaviour. And a central bank's ability to require other market participants to operate in accordance with a market code of conduct will suffer if it is known to have a lax attitude itself to obeying market standards.

In summary, compliance may not seem important but it is an essential element of successful reserves management. Some compliance issues concern the law, and these should always be a priority. Others concern risk control; these too are essential for anything other than the simplest operations. Ethics may seem the optional extra but attention to ethical standards is crucial to preserving a central bank's reputation and ability to deal effectively. Weak compliance standards will not necessarily result in immediate losses either in returns or in reputation, but it will damage a central bank's long-term success, and not only in the area of reserves management.

6.2 The role of the Middle Office

It is a standard principle that for a check or control to be effective, it should be administered by someone independent of the person being controlled. In the case of reserves management, this means that the administration of the various controls, limits and so on which cover the reserves managers should be conducted by someone other than, and independent of, the reserves management unit itself. Similarly, it is sensible for valuations and profit figures to be calculated by someone other than the portfolio managers, to eliminate any suspicion of "favourable pricing" or of losses being hidden.

It is not essential for these two functions of portfolio control and portfolio evaluation to be combined, but given the overlap between the two there is much merit in doing so and this is increasingly the way many central banks work. The norm and best practice is for the two functions to be carried out by a single unit separate from the reserves managers, and this is usually known as the Middle Office. (The name is by extension. The dealers and portfolio managers are often known by the collective term "the Front Office", and the settlement function is usually called "the Back Office". The compliance and control function, which sits between the Front and Back offices and was in many central banks the last to be set up as an independent unit, thus naturally became known colloquially as "the Middle Office", whether or not it had some more formal name such as Compliance Unit or Risk Monitoring Division).

The effectiveness of the Middle Office relies greatly on its separation from the reserves management function. The Middle Office should not therefore be

involved in any actual reserves management trading decision, and by extension should also have no input into decisions on, for example, the positioning of the benchmark. These are for the reserves management unit and their line management. Rather, the Middle Office plays a "before and after" role:

- before trading, the Middle Office determines (with senior management) what instruments, credits, currencies etc are to be permitted, and will set limits for all of them. It will establish the procedures that the reserves managers should follow, and will set up all the necessary legal agreements and documentation.

- after trading, the Middle Office checks that everything has been correctly recorded, and that none of the limits, controls and other elements of compliance have been breached. It will report any breaches to senior management, and should also provide valuations and profit reports to the reserves managers. Finally the Middle Office is usually the main conduit to the internal and external auditors, and may also handle external data releases on the reserves.

This separation benefits both the Middle Office and the reserves management unit. However, the Middle Office is nevertheless part of the central bank, and one question which needs to be resolved is the level at which the Middle Office management comes under the senior management of the bank. If this is at too junior a level, there is always the risk that the reserves managers will be able to overrule or simply ignore anything that the Middle Office says that inconveniences them. But a Middle Office which is too separate from and distant from the reserves management operation can be equally damaging if their decisions are in conflict with the overall policy for the reserves as set by senior management. The Middle Office management needs to be sensitive to the requirements of those that are actually managing the reserves; there is no point in setting such tight limits and controls on risk that the reserves managers' task is made impossible!

One issue that arises is the role of the Middle Office in computer support and development for the reserves management operation. There is often a dilemma here between the need for the computer support team to be fully familiar with markets and the reserves management operation, and the need also for the computer systems to be separate from the portfolio managers themselves so that there is no risk of the systems being tampered with by portfolio managers seeking to influence the evaluation process.

This need to preserve the integrity of the computer system from possible interference argues for the computer support function to be outside the reserves

management unit; in any event, the reserves managers will usually not have either the time or the skills required to maintain complex computer systems. But a completely separate computer specialist team may find it a challenge to have the deep knowledge of the markets and market practices that is required to build a system which is both effective and user-friendly. Once again this is a role that can often be filled to good effect by staff of the Middle Office, who are both separate from the reserves managers and also fully conversant with the market.

6.3 Contact with the market

This is a difficult area for many central banks. Reserves management requires important decisions involving large transactions with the market to be delegated to relatively junior staff, and this is often in conflict with the more general style of central banking where, typically, contact with the outside world is treated with great care and reserved for the more senior echelons of staff only. But contact with the market cannot be avoided and moreover must occur at the portfolio manager level. It is thus very important that the portfolio managers are fully familiar with the way in which their counterparties operate and view the relationship between the central bank and themselves.

A market contact can act for a central bank in a number of ways, for example as a custodian, as a debt management adviser, as a general adviser on investment issues, as a source of training expertise and as a counterparty for reserves management deals. This section considers the last of these, which is the main area the portfolio managers are involved in and also the main area in which financial loss can occur if the relationship goes wrong or is not under control.

In many markets a house puts its services and expertise at the disposal of clients but not its own balance sheet. For example, in the FX and commodity houses, houses usually act as brokers or middle-men between principals. In the securities markets, however, houses usually act as principals themselves. To do this, they run books, and in managing their own positions they often seek to initiate trades. This element of securities trading, the fact that a securities house may approach a central bank to propose a trade, requires the central bank portfolio managers to trust them more than one needs to trust a broker, and this requires regular contact and dealing as part of building a relationship.

On the securities house side, the establishment and maintenance of this relationship is the task of the salesman, while it is also a key duty of the central bank portfolio manager. Both sides will need to establish and maintain close contact so that they understand and trust each other. Because of the effort involved, most salesmen will have only a few (under 20) accounts. This introduces an interesting dynamic:

not only is the central bank dependent on the salesman, therefore, but the salesman is also dependent on the central bank, and on his relationship with it.

Nevertheless portfolio managers need to be aware of the potential for conflict of interest for the salesman, between the interests of the securities house in general as his or her employer, and the health of the relationships with his clients. The potential for conflict of interest is usually reduced by the fact that the salesman does not run positions himself; instead he acts as the link between the trading desk in the securities house on the one hand and his clients on the other. But there is still a potential for conflict and a balancing act: if the salesman puts the interests of his traders too high he will not do much business and will lose his clients, while if he puts the interest of his clients too much to the fore he will lose money for his employer and possibly his job.

It is here that the central bank portfolio manager can contribute to a successful partnership. He or she needs to be able to judge when the salesman needs some help and when to hold out for a hard bargain. An open co-operative approach is more likely to be reciprocated with genuinely helpful service than a poker-face, while on the other hand a portfolio manager who tries to "score off" the houses he or she deals with will find that they will reciprocate here too. Despite the fact that the securities house is on the other side of the deal, so that a slight change in the price of a deal that benefits one must cost the other, relationships in reserves management should not be adversarial and the best relationships are usually not "us against them", but "them helping us to beat the market". Senior management should accept that building such relationships requires skills and activities not typically found in other parts of the central bank; in particular a degree of corporate hospitality which would perhaps be inappropriate elsewhere in the central bank may need to be sanctioned.

6.4 Other constraints affecting official reserves management

To close this chapter we look at four constraints on a central bank's reserves management operation that are often overlooked. These are Situation, Staffing, Systems and Settlement.

A central bank's geographical situation is clearly not something that the senior management of the bank can easily change! Nevertheless it is important to bear in mind the constraint it imposes when deciding the reserves management style. If telephone communications are irregular or unreliable, or wire service information is unavailable or prohibitively expensive, this will militate against a style that takes large positions in fast-moving markets. Equally, the central bank's time zone may be relevant: it is easier to manage a yen portfolio actively, for example, from Asian time zones than it will be from a European or American base.

Staffing is a major issue for all central bank reserves management operations. The skills required for reserves management are typically not widely found elsewhere in central banks and the reserves management unit often has to devote considerable resources to training newcomers to the team. The "learning curve" is typically steeper and longer than in other functions and areas in the central bank. This places a premium on keeping staff once they have benefited from this extensive (and expensive) training. Unfortunately, portfolio management is a very marketable skill and, especially for central banks situated in major financial centres, the threat of losing staff to the market is considerable. This places an emphasis on simplicity of operation and on documentation: a central bank cannot afford to lose too much of its accumulated knowledge when staff resign, and the best defence against this is to ensure that no single part of the operation is controlled by or understood by only one person.

Systems issues can also constrain a central bank's reserves management operation. It is essential that the IT systems can handle everything the reserves managers wish to do, otherwise there is a risk that positions may get out of control and risks and losses may escalate. IT systems for reserves management are however complex and expensive, and sufficient resources need to be devoted to their construction and ongoing maintenance.

Finally, settlement and accounting problems have the capacity to be a major constraint on reserves management. It is pointless trading in instruments that the settlement office cannot settle, and even if the deal can be settled, it is very dangerous to trade in instruments which the accounting system cannot value or account for properly. This in particular is an area where the Middle Office must act as the liaison between the reserves managers and the more administrative side of the bank; to the extent that, if the portfolio managers propose a new instrument, they should not be allowed to trade in it until the Middle Office has formally checked that it can be correctly handled by the settlement and accounting parts of the bank.

7 Reporting

7.1 The importance of reporting

Given the great degree of delegation in reserves management, the importance of maintaining overall responsibility and control as the counterpart to this delegation has already been observed (see section 2.5). As well as a formal structure of decision-making and a formal monitoring system to ensure that limits are adhered to, this requires a comprehensive reporting system, through which senior

management can observe the consequences of the investment decisions their portfolio managers have undertaken.

However, portfolio performance reporting is not simply the method by which senior management see how much return the portfolio managers have earned, important though this is both in monetary terms and for more general staff appraisal and management purposes. It is also the way in which senior management can assess their own decisions (is the benchmark correctly positioned? Is the policy on liquidity, or on credit, operating as desired?). It provides the base data for more public reporting and accountability, for example to parliament. And through published data and the statistics on reserves holdings given to the IMF it adds to the data available to those pursuing international financial stability and can act as an early warning of financial strain on a country's foreign exchange position.

7.2 Internal reporting

An internal reporting system should be regular, frequent, and timely. Reports should be regular so that there is no possibility of awkward or unpleasant news being covered up. They should be frequent so that management can maintain close control and stop a situation getting out of hand before it goes too far. And they should be timely (ie, reporting should be as soon after the period being covered as possible) to ensure that if there are problems senior management can act before serious damage is done.

The content of the internal reports will be largely for each central bank to decide for itself. But as a minimum, internal reports should cover the external environment, the portfolio manager's response, and the results of actions taken. Thus a well-constructed report will give, as a minimum:

- a (brief) description of economic and market developments over the reporting period, to show management that the portfolio manager has been alert in his or her market analysis;
- a description of the various positions taken during the month in response to market movements, to show management how the portfolio manager responded to his or her analysis of the market and what changes were made to the portfolio;
- an analysis of the results of these actions and the returns made on the portfolio, to show how the profits earned relate to the positions taken.

Note that the purpose of the description of economic and market developments is to support the positions and returns analysis, not to provide an in-depth economic assessment. Quite apart from the fact that the essence of the end-month note is timeliness, and overlong economic analysis will slow down its production, others in the central bank will be doing similar analysis anyway, and the reserves managers are unlikely to be the best placed to do this work.

A more detailed report might also include a forward-looking section to set out for management how the portfolio manager expects the market to develop, and how he or she is positioned to take advantage of this. This may or may not include such details as scenario testing or stress testing, but should certainly include a list of all open positions (with, if possible, their current mark-to-market valuation). A full position report might therefore read as follows:

Position	A long position of $20 mn 10 year treasury notes
Opened	17 June 2000, at 100-19 (yield 5.54%)
Rationale	Downtick in market seemed overdone; bull trend looks still in place
Current level	101-7 (yield 5.46%) on 1 July 2000; profit in position $125,000
Strategy	Trend expected to continue, target to close 101-16 Stop loss position to take trade off 101-00; would lock in $81,250 profit

A report such as this should be presented to management for each open position, with supporting text as required to explain the positions further or to explain how they fit into the portfolio manager's overall analysis of the market and strategy for the portfolio. Other elements of the report will depend more on individual circumstances and senior management preferences, but might include details of cash usage over the month, limit observances, risk positions, a breakdown of deals done with each counterparty, and so on.

As already stated in chapter 6, it is essential that hard figures such as positions, limit observances and returns are reported by the Middle Office. This is to avoid any risk that portfolio managers could amend or hide uncomfortable news. Equally, judgmental elements of the report must come from the person responsible; ie the portfolio manager. This is to ensure that the reason behind every position or profit is given by the person taking it or making it. The final report might therefore

be structured as a body of text (analytic report, from the portfolio manager) with an annex of figures (factual report, from the Middle Office accounting unit).

7.3 External reporting

External reporting of a central bank's reserves management operation serves two main purposes. The first is Accountability: the reserves are public assets and the central bank should account to the public for its management of them. The exact method of making public the results of the reserves management operation (eg in the central bank's annual report, or in a special report to parliament) and the degree of detail that is reported, is for each central bank to decide. The most detailed reports will not only set out the size of the reserves but also explain the reserves management process, the benchmark used and perhaps even the returns due to active management against that benchmark. Not all central banks will want or feel able to go into this much detail but as a minimum the central bank's report should be sufficient to show that the reserves are all accounted for and are being managed according to established procedures.

The second purpose of external reporting is for Information, both to the IMF and others in the official sector and to other market participants. The size of the reserves can show how much intervention a country has been doing, and can also provide reassurance to creditors on the creditworthiness of the country. More detailed figures (as set out by the IMF's current Data Dissemination Standards) provide valuable data for those in the official sector whose remit includes the maintenance of international financial stability. Particularly for this purpose, it is important that the data is kept up to date: confidence in a country's external position can quickly be lost if regular reserves data releases start to be delayed or withheld from publication.

8 The use of external managers

8.1 The decision to use external managers

Traditionally, most central banks have not made great use of external fund managers. There have always been exceptions to this rule, but as recently as the start of the 1990s, the number of central banks who put a part of their official reserves out to external management was very small.

More recently this position has begun to change. Faced on the one hand with the increasing costs of keeping IT systems in tune with modern sophisticated markets, and the increasing difficulty of retaining staff of the calibre required to manage

portfolios actively, but on the other hand with no desire to return to the low risk and very low return styles of the past, there has been a notable trend for central banks to begin to consider afresh the attractions of employing external managers. In a sense, this is merely a manifestation of the current management trend towards outsourcing: central banks are increasingly prepared to query why they should try to manage all their money themselves if and when it can be profitably outsourced to the market.

The traditional arguments against external management for central bank FX reserves revolve around three main points. The first of these is security: central banks require their assets to be absolutely secure, and have in the past been nervous about committing their funds to institutions which might be excellent fund managers but whose security and creditworthiness fell short of the most exacting standards. The rise of specialist global master custodians, and the resulting ability to split management of funds and custody of assets, has gone a long way towards reassuring central banks that funds placed with external managers can be made sufficiently secure.

The second point is liquidity: central banks often require their funds to be instantly available. This was widely seen as implying that only reserves not needed at all for liquidity could be given to external managers, as with an average recall time which might even be as much as two weeks, the funds were not available for rapid use. Recently, however, the growth of repo markets and other such tools has greatly reduced the time it takes to recall funds from an external manager, while at the same time use of the FX forward and swap markets has increased a central bank's ability to fund itself short term to meet a sudden call for liquidity.

Finally, central banks have traditionally always placed a very high emphasis on confidentiality. This remains a serious concern, and indeed some central banks will not even consider outside managers for this very reason. However, other central banks are increasingly adopting a much more open style in their reserves management, and sharing their objectives with carefully selected external managers is increasingly seen as not inappropriate or incompatible with overall confidentiality requirements.

With the ability largely to overcome these three main traditional concerns, central banks are more able to focus on the benefits of external management. Traditionally, these have included:

- a diversification of investment styles and views;

- the ability to make use of expertise that the central bank does not itself have. Those central banks that invest part of their reserves in equity

portfolios often put some or all of these out to external management. Other central banks, particularly smaller and newer ones, use external managers to provide not just fund management but also an element of training for their staff;

- the use of external managers and external portfolios as a yardstick for performance comparison for the internally managed portfolios;

- the review process that the central bank conducts with its external managers enables the central bank to draw on the knowledge and experience of a diversified group of external opinions. The managers can provide a valuable and important source of market information, judgment and technical expertise which complements the internal analysis, and as a result the central bank is better informed and less at risk of relying solely on the opinions of the in-house staff;

- a greater anonymity in the markets (sometimes very useful, especially in, for example, the FX markets);

- a greater understanding of how the private sector assess the risks and rewards of different investments and investment styles;

- an opportunity to promote and develop a local fund management industry (particularly attractive to some central banks of emerging markets, who will often find advantage in putting some of their assets out to local fund management operations);

- finally, external portfolios enable a central bank to manage money outside its own time zone. Despite the enormous improvements in communications, this remains valuable for many central banks, as many markets still show patchy liquidity outside their own business hours. The use of external managers also helps to mitigate any price risk by placing funds with managers located in the time zones of the markets in which they trade, where liquidity is better.

To these can be added the two very considerable benefits of tapping into the managers' IT and risk control systems, and utilising the managers' professional staff. By using external managers, the pressure on the central bank to keep its own systems abreast of the market and its own staff fully conversant with the latest market developments is reduced - not eliminated - and a central bank may also be able to call upon its managers to assist in any IT upgrade or staff training. Equally, the central bank is much less affected by the resignation of key portfolio manager personnel; an important point for many central banks where the old-style "40 year

career", and with it the expectation that staff will stay at the central bank almost regardless of the outside employment market, is fast becoming a thing of the past. The extra cost of the external managers' fees needs to be considered in the light of this much greater stability of staff and systems that they provide, and not just in monetary terms.

For all these reasons (and not least among them is a greater focus by the fund management industry itself on the central bank sector as a source of potential clients), acceptance of the role of external fund managers in reserves management is growing and is likely to continue to grow.

8.2 The relationship between central bank and fund manager

The relationship between the central bank and the external manager is complicated by the fact that the manager operates in two capacities. On the one level, with regards to the central bank itself the manager is dealing as principal to principal; it will have its own interests to look after and its own legitimate concerns. On the other hand, with respect to the assets the manager is in the position of an agent, and has to follow the central bank's instructions. This dual role is best handled with a two-part legal agreement separating the two functions.

The first part of the agreement should be the legal documentation for the management contract. It is an agreement between equals, and should set down agreed terms for how the manager manages the assets, the frequency and type of reporting, the arrangements for custody of the assets, the frequency of review of the mandate and notice period for termination, any special arrangements for the recall of the assets and the fee levels. The central bank may also want to include access for its own auditors to the manager's operation, acceptable return and tracking error levels, and other such details. The key however is that all these are terms and conditions which are <u>for negotiation</u>, and both sides must agree to them.

The second part of the agreement covers the instructions from the central bank as owner of the assets to the fund manager as agent and manager of the assets. These will include a specification of the benchmark, a list of authorised instruments and currencies, limits on individual exposures, lists of acceptable credits and so on. This part of the agreement will probably be fairly similar to the guidelines given to the in-house portfolio managers. The key differences between this part of the management agreement and the legal documentation is that in setting these guidelines the central bank is able to <u>dictate</u> the way the account will be run, rather than seek agreement through negotiation. A good external manager will always enter into a discussion of the merits of a set of guidelines if invited to, and will probably express misgivings if the guidelines contain obvious flaws or

inconsistencies, but ultimately, short of withdrawing from the management agreement altogether, the manager has to accept whatever the central bank wants.

A final merit of separating the two halves of the agreement is that the former legal part will probably not be amended very often, while the central bank may want to change the latter part comparatively frequently. If the two parts are separated it is easy to amend the guidelines without touching the much more sensitive legal documentation; indeed, the central bank can do so unilaterally. If the two parts of the agreement are intertwined, even the simplest of changes to the guidelines may require the central bank to secure the manager's agreement to a fresh legal document.

8.3 The central bank's responsibilities

Like anyone else who employs outside management for their assets, central banks who do so need to appreciate that while the actual physical management of the assets (investment and settlement) can be delegated to an external manager, responsibility for those assets and their administration and accounting cannot.

The choice of benchmark, allowable instruments and so on must clearly remain with the central bank, and the central bank also has a duty to make sure that the combination of benchmarks and expected returns are consistent. There is little point in setting a manager a target of generating a LIBOR-plus return, for example, if the approved instrument set only encompasses treasury bills. Equally, such "dual benchmarks" as a requirement to match the 5 year bond yield while not losing money (a not untypical target for external managers) is impossible to achieve in a downward-turning market unless options and portfolio insurance are allowed, and very difficult to achieve even if they are.

A central bank will also wish to handle its own accounting for the assets under external management, and may have to handle such matters as tax as well. While an external manager's valuation of the portfolio will probably suffice for general performance monitoring purposes, few central banks will want simply to incorporate such a valuation into their own formal report and accounts. Instead the positions should be recorded and then priced up afresh, using prices that are consistent with those used for the internally managed assets.

Another issue facing the central bank is how many external managers to use. In general, it is preferable to employ a number of managers rather than rely on just one or two; this diversification can help protect the overall return from suffering too much if one manager performs badly. However, against this must be balanced the fact that the more managers that are used, the higher the administrative overheads will be. Furthermore, there is always the challenge of terminating the

contract of an underperforming manager. A fixed review period for the renewal of a contract can lead an underperforming manager to take undue risks as the renewal deadline draws near, especially if they deemn they have little to lose but may just retain the contract if the gambles succeed.

Finally there is the question of risk and credit limits. The central bank will obviously give the external manager a set of limits, but the issue then arises as to how to monitor compliance with them. Some central banks may be content with random spot checks. Others will ask for a daily report of all risk positions to ensure they are within limits – this can be done, but may prove expensive, and if the central bank has a large number of external managers the administrative overhead involved in checking them all will be substantial. The most detailed method of monitoring is for the external managers to report each trade as done, but the administration of such a system is a further order of magnitude more involved.

One question that often arises is whether limit headroom not used by an external manager should be made available for the internal portfolio managers. For example, consider the case where senior management set a limit of 100 for a certain position. The central bank employs an external manager, and sets a sub-limit of 20 on the external manager's position. The external manager in fact only uses 5 of the limit, leaving 15 unused. Should the limit for the internal portfolio managers remain at 80 or can it be increased to 95? In general, it is difficult to reallocate limits like this, because of the need to inform the external manager that their limit has temporarily been reduced to 5. And if a central bank employs a large number of external managers, shuffling limit room like this can become very complicated indeed, and is prone to errors and misunderstandings. But the consequence of dividing up a limit between several external managers is likely to be that there are several small amounts of unused limit, which can add up to a considerable amount. As a general rule, the more managers a limit is divided up between the less the average overall usage of the full limit room. Senior management may wish to bear this in mind when setting global limits.

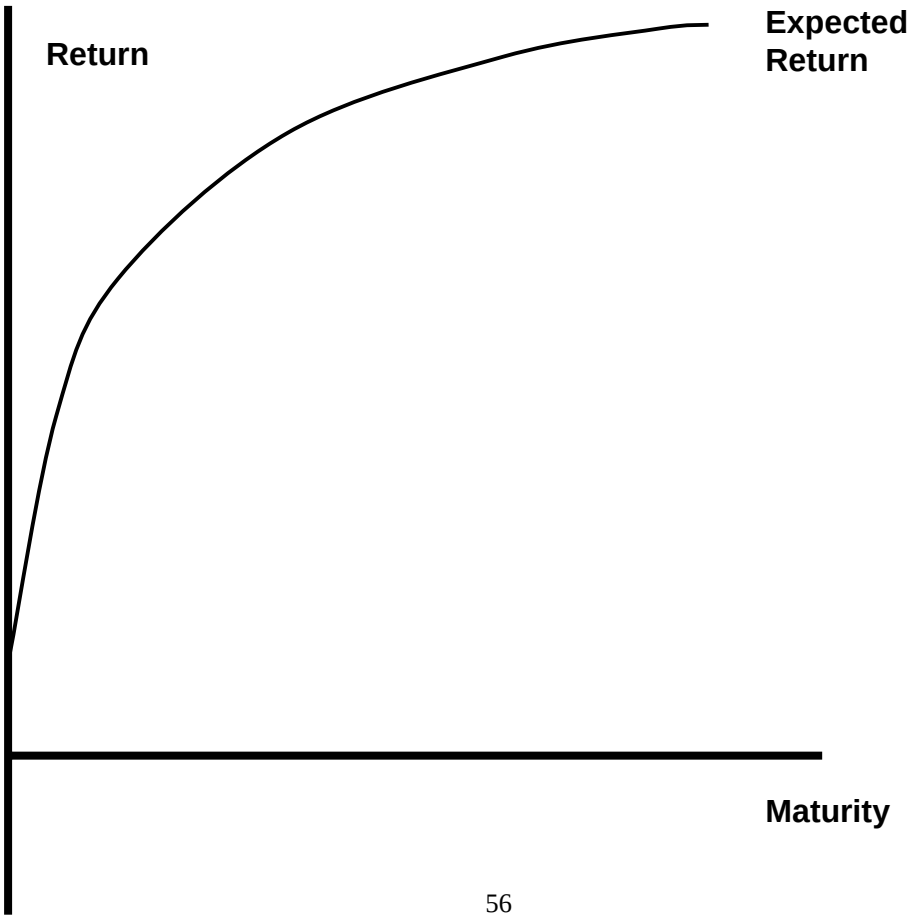
For all these reasons, the management of external managers is more complex and resource-intensive than it may seem on the surface, and any central bank thinking of employing external managers should consider the resources that they will have to devote to running the external portfolios before deciding to go ahead. This is particularly the case if the central bank, for reasons of diversification, intends to appoint a large number of external managers. But despite these overheads there are many advantages from employing external managers, as section 8.1 above has set out, and the trend of increasing central banks usage of external managers looks set to continue.

Appendix A: A more detailed investigation of the optimal duration of net reserves

In setting the neutral benchmark for the reserves few decisions are as open to debate as the issue of the neutral duration. For the currency decision there are established guidelines which can be used (for example the currency of debt to be hedged, or the currency of the main trading partners, or the main intervention currency). And for the instrument decision, the central bank's credit and liquidity preferences will usually be a good guide. But the decision on the neutral duration is less well defined.

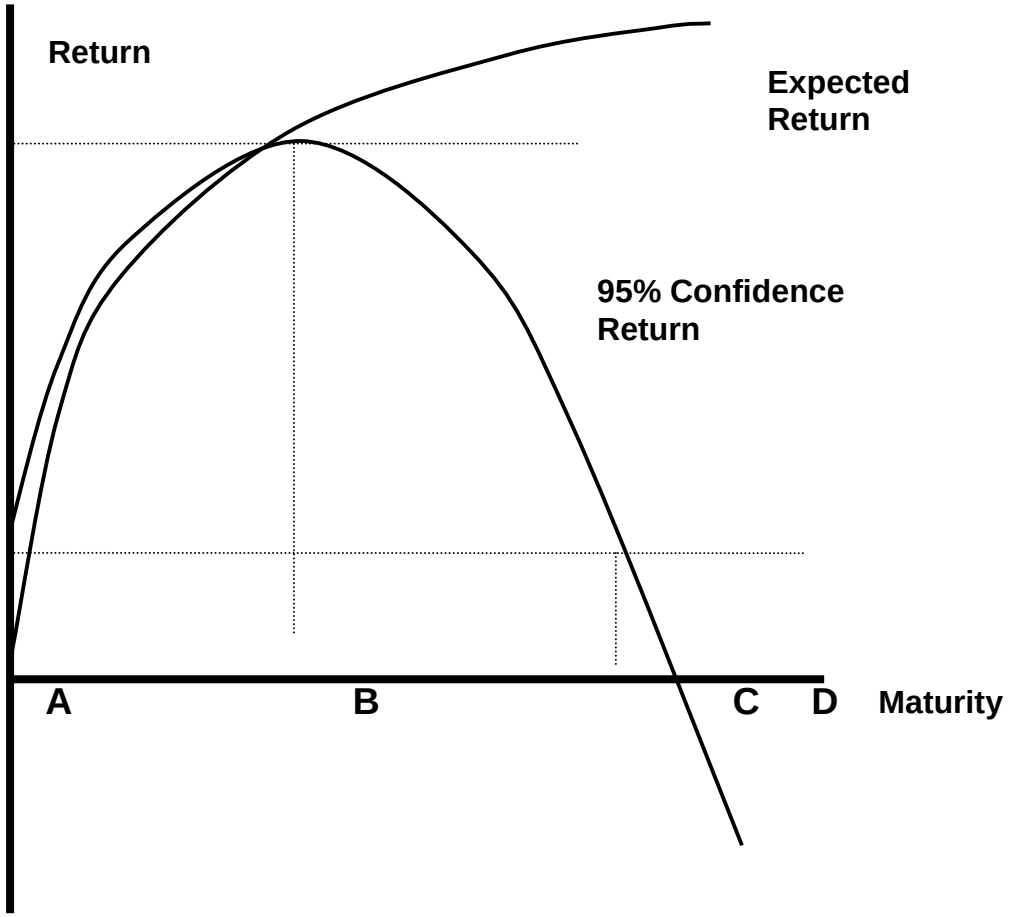
The heart of the decision is the observed fact that, at any rate at the short end of the yield curve where most central banks will be most active, a marginal extension in duration usually generates greater expected returns but also carries with it greater volatility of returns. A decision to extend duration can therefore be seen as one of seeking extra expected returns at the cost of greater volatility. As such there is no "right answer" to the question of the optimum duration, as it will depend on each central bank's risk-return preference.

Nevertheless theory and observation can be used to guide the decision. As a first step we construct the expected return for instruments of varying maturity over the measurement period, which can be plotted on a graph as below.



In most markets, most of the time this graph of expected return will be upward sloping, reflecting both the increased premium for long maturity paper and also the effect of roll-down (that is, bonds of a longer maturity fall in yield as they approach maturity and so for the holding period in question the return is enhanced by capital gain).

Central banks, however, are typically not so much interested in the expected return as in the worst case return. One way to incorporate this into the analysis is to plot the "95% confidence return", defined as the return that the market should provide as a minimum with 95% confidence. Another way of putting this is that 95% of the time, the return should be at least as great as this return. This"95% confidence return" line is shown in the graph below; alternative confidence lines at 99% or even higher could of course also be used:



For the shortest maturities the return is certain, and so the 95% Confidence Return is the same as the Expected Return. If, for example, returns are measured and recorded using a one month reporting period, then any instrument of maturity less than a month has a certain return as it will have matured by the end of the reporting period. In particular, this is true of point **A**, which minimises risk. Thereafter the

volatility of the return grows, so that the 95% Confidence Return is increasingly further below the Expected Return, until eventually the line becomes negatively sloped and eventually goes negative.

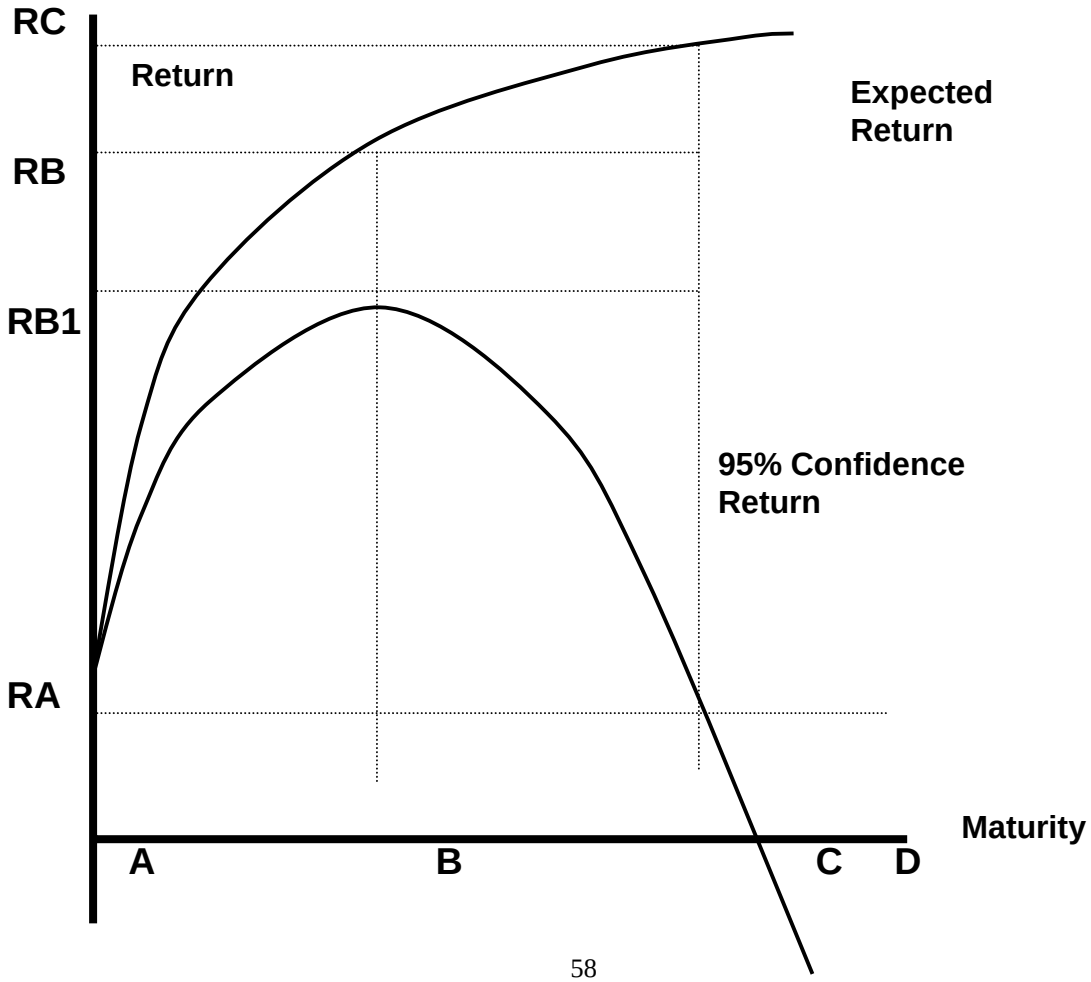
Some other points of interest have also been added to the chart above.

- Point **B** maximises the 95% confidence return. Note however that this is not the same as the point of maximum expected return.

- Point **C** guarantees (with 95% confidence) at least the minimal-risk return. Holding assets at point **C** will (with 95% confidence) yield *at least* the minimum risk return that assets held at point **A** earn.

- Point **D** guarantees (at 95% confidence) at least a positive return. Assets held at point **D** will only produce a loss 5% of the time (ie once in 20 reporting periods).

The analysis can now be used to assess whether the expected increase in return from extending in maturity/duration is consistent with the risk tolerance of the central bank with 95% confidence. The chart below repeats the last chart but with some additions to show returns.



The increase in expected return from moving from a portfolio at point **A** to one at point **B** is **(RB-RA)**. This is a substantial extra return for limited extra risk, and most central banks will consider this worthwhile. Even in adverse circumstances, an extension from **A** to **B** should generate greater returns, as the 95% Confidence Return for a portfolio at point **B**, **RB1**, is still greater than **RA**.

Moving the portfolio further out along the duration curve to point **C** adds less return, as the increment is only **(RC-RB)**. Moreover, it cannot be guaranteed with 95% confidence that such an extension will generate greater returns, as the 95% Confidence Return for a portfolio at point **C** is by definition back at **RA**, which is less than **RB1**. Nevertheless, for central banks able to take a longer view and with less requirement to minimise the loss from each individual reporting period, the extension from **B** to **C** may be attractive. However, a further move to point **D** adds very little extra expected return, while adding considerably to the risk of underperformance in adverse markets. The risk-reward pay-off for a move from point **C** to point **D** is usually not very attractive for central banks.

Practical Application

Application of this analysis to a specific market requires the estimation of the Expected Return line, plus an estimate of the volatility (standard deviations of returns) so that the 95% Confidence Return can be derived. This can only be done through analysis of past actual data. For any given market the model will therefore be dependent not only on the choice of instruments (for example, government bonds only or a wider investment universe) and reporting period, but also on the data period. Some markets will display more stability over different data periods than others; if the analysis for the chosen market is shown to be highly period-dependent then a precise derivation of points **B**, **C** and **D** from the model may not be possible.

Ilmanen (1995) (see bibliography) discusses this issue in some detail, and concludes that, for the US Treasury market at least, the overall findings are indeed relatively period-specific. Nevertheless, there is a clear indication that the effect at the shortest maturities is fairly stable; that is, the part of the chart from point **A** to point **B** is relatively well defined even if at longer maturities the stability of the analysis decreases.

For the central bank planning the neutral duration of the benchmark for their reserves, the key use of this analysis is not so much the identification of the exact maturity that corresponds to point **B**, for example, or point **C**. Rather, it is in identifying that

- in setting the neutral duration, risk minimisation may not be optimal;

- some extension from a very short neutral duration is likely to bring greater returns even in adverse markets;
- however there comes a point beyond which further extension may bring extra expected return but is associated with markedly increased volatility of returns.

This can then be used as the basis for assessing qualitatively what their risk appetite is (ie, where the central bank's preferred habitat is relative to **A**, **B** and **C**), and this in turn will help inform consideration of the preferred benchmark duration.

Appendix B: Computer Support for Reserves Managers

This Appendix discusses the level of computer support that a central bank should provide for its reserves management operation. The issues discussed below highlight some of the considerations that should be borne in mind when specifying either a new system or any development of an existing system.

Identification of requirements

It is unusual to find one package that meets all the various needs of the reserves management operation. Instead one should identify the various different needs separately, and then consider which computer package is the best to satisfy each individual need. If this is done it is probable that a number of requirements will be identified, such as portfolio analysis and returns, accounting, risk monitoring, settlement, and no one package will exist that will meet all the separate requirements. On the other hand there is obviously merit in avoiding too great a proliferation of computer systems, and the best solution is seldom to set up a specialist stand-alone system for each individual task. The best computer support will most probably consist of 2 or 3 largely self-contained systems, each performing a range of major tasks, but each also linked together in some way to ensure consistency of data, minimisation of data entry, and so on.

The first task therefore is to identify the reserves management operation's needs. For an investment manager, the world can be divided very simply into two. There is his or her portfolio, and there is everyone else, which we usually call the Market. Similarly, time can be divided equally simply into three: the past, the present and the future. Combining these two divisions gives six possible areas of interest, shown schematically in the diagram below. The computer support for each of the six areas will be required to answer different questions, and this may well require separate solutions to be found in each case.

The different areas of interest to Reserves Managers

	Own Portfolio	**The Market**
PAST	Records of past trades and profits Audit trails	Bond descriptions & static details Yield and price histories
PRESENT	Trades and holdings Exposures against benchmarks Credit control	Market screens & comment Economic indicators Yield calculators & general bond mathematics
FUTURE	What-if scenario analysis Horizon analysis Portfolio optimisation	Market predictions Chartist analysis Economic forecasts

Information on the market, whether past, present or future, is not something that needs to be specially tailored for a central bank investment manager. Their requirements will be largely the same as those of other investment managers, and it is not necessary to set up something individual or unique. Instead, the central bank should use the systems that the market uses, which in essence means the main wire services systems.

By contrast, the computer support for the central bank's own portfolios is likely to benefit from special tailoring. Although the aims, objectives and methods in central bank reserves management will in many ways be similar to the market's, central banks operate in a unique environment, and the constraints (and presentation of results) will be very different. This naturally leads to different computer needs. Furthermore, even if it was possible to find the ideal portfolio monitoring and analysis package on general release, a central bank would always prefer to hold it on its own internal system, as this both allows customisation and also protects confidentiality. The external solution, such as a bureau package, is unlikely to be acceptable to the majority of central banks, simply because of the question of security of information.

The present state of the market

The provision of information on the present state of the market will usually come from external wire services. The system chosen should include as a minimum current price and yield data, announcements of economic indicators, and official (central bank or government) financial announcements. The most important

considerations to bear in mind are timeliness, ie how quickly the screens are updated; accuracy, ie how reliable the information on the screen is; and relevance. This last point is important because if a central bank is investing in the bond market, but its wire service is predominantly aimed at equity players, then items of news relevant to the central bank are liable to be lost in a mass of company-related information.

Many wire services also include market comment, news analysis and other such information. How much use is made of this is a matter of personal preference. Some portfolio managers prefer to receive their market information of this sort via the internet or direct from the salesman at the counterparty. Apart from cementing the personal relationship, which above all else is crucial to successful and profitable portfolio management, direct contact also enables fund managers to discuss and interpret the information rather than just receive it cold.

More complex systems can include other trading aids to help portfolio managers follow the day's movements, such as charts of intra-day movements in securities and futures markets, or support and resistance points. Most systems are also interactive, and provide much mathematical power, such as yield calculations or cheapest-to-deliver analysis. For all these, however, there will of course be extra costs, and it is up to each individual central bank to decide how much can be justified.

The present state of one's own portfolio

This is almost always best done on the central bank's in-house computer. This is for three main reasons. Firstly, and most importantly for a central bank, an in-house system will be more secure. The second reason is ease of access. An outside package, for example at a global custodian perhaps, may well be more difficult to get access to, and there are risks that the system will not be available on demand. Finally, an in-house package is usually easier to customise, maintain and develop. This is crucially important in fast moving markets, where investment managers will wish their computer support to be able to handle the very latest market innovations within a very short time of their introduction.

The basic requirements of any package are information on holdings, recent trades and positions relative to the benchmark. These are the minimum requirements without which it is impossible to maintain control over a portfolio; if the package does not provide these essentials the portfolio manager will almost certainly be recording them by hand anyway.

Other highly desirable features include credit control details, such as an analysis of holdings by issuer; open swap positions, by counterparty; and for deposit and

liquidity portfolios, some form of cash flow analysis to help the portfolio manager keep control of the funds he or she is responsible for. More advanced systems might also include report generation, for example, graphics of the distribution of the portfolio across the maturity range; trader-entry of trades, which helps ensure that trade details are entered promptly and (one hopes) correctly; and links to settlement systems, with automatic generation of telexes and adjustment of cash balance records, etc. If in addition there is some link to a price database, more sophisticated features can also be included, such as flagging of swap targets to alert the portfolio manager when a swap has reached the desired profit level.

One of the most important decisions that has to be made at the outset is who will build the computer system. The choice is usually between buying in a package, and building one in-house. With a bought package the central bank does not have full control over what it does and how it does it, and as a consequence the final package risks not meeting all the requirements. In addition, maintenance and enhancements may be difficult to arrange, especially if the package remains a black box and the central bank is not allowed access to the source code. For this reason, many central banks prefer to build their own computer system, or at least customise a supplied package. It is important to realise that this will take a considerable commitment in terms of time and effort from both the computer support and also the investment team if the project is to be done properly.

The past history of one's own portfolio

This part of the computer support system is usually an integral part of, and flows logically from, the programs that provide the information on the present state of the portfolio. They share much of the same data, such as trades done and past holdings, and the creation of the data for the historic part of the support package should naturally flow from the data input for the current state package.

However, one should expect more from the IT system than just a record of where the portfolio was and what trades were done. At the minimum, the support package should provide a record of past valuations and cash flows, so that returns and profits can be calculated over fixed past periods. A more advanced system might be linked to a full price database, so that returns and profits can be derived for <u>any</u> past period. Whether this information is held on the central bank's own computer, updated daily by some sort of wire link to a market source, or whether there is a direct link into someone else's price database is largely a question of individual preference, depending on the cost, reliability and availability of the data.

Other features that should be considered include records of swaps with individual counterparties, so that past performance and profits generated can be reviewed, and an ability to reconstruct the past, so that it is possible to produce the portfolio's

position on a given date. In addition the better systems will also contain the usual reporting facilities, such as table and chart generation.

A major question which needs to be considered when deciding on your computer support in this area is whether the package is designed solely to provide management information, or whether it is also to provide accounting and audit information for the internal audit department. There are sound reasons for building a system which is also capable of satisfying auditory requirements, as much of the information needed by the audit procedure, such as the trades done and the prices they are done at, will already be contained on the management information database. But against this, the accounting methodology used by the audit department may not be the same as those used by the portfolio managers. For example, many formal accounts still work on the basis of historic book value costs, whereas a portfolio manager will instead be using mark-to-market principles. The processing required to satisfy the audit requirements will be an extra overhead on top of the management information system which will certainly add to development costs and may also add to running costs.

The decision on whether to include anything for the audit department in the reserves management system is in the final resort one for each institution to make for itself, but the reserves managers will need to be aware of the extra costs to them of using their management information system to provide the internal auditors with the extra information they need.

The past history of the market

Information on this is best supplied by an external source, as the effort required to maintain an in-house database of the market's history makes doing it oneself prohibitively expensive. An external service will also be able to provide much more comprehensive coverage than any internal package, and will in addition be more likely to have the correct conventions in for example the various yield calculation routines.

There are several systems on the market that a central bank might buy, and in addition most of the major securities houses have some sort of proprietorial package which they may or may not allow access to. Although a package from a securities house may well be cheaper, it may prove a false economy to rely on one. Even if it is as good and as comprehensive as one of the specialist systems, by taking it the central bank will be linked into just one price source with no way of comparing that house's view of history with anyone else's.

The minimum that a central bank should look for from a system includes price and yield histories (in both tabular and graphical form); spread histories between two

instruments (again, including graphics); yield and other calculators for any past date; and a database of static details for every security on the system. These are essentials, and any system which does not have at least these is unlikely to be worth serious consideration. More advanced systems also include intra-day price movement charts, both for cash markets and derivatives markets, and more detailed technical analysis tools. If the reserves management operation includes derivatives, then these will certainly be very valuable. From the reporting angle, customised screens, for eg individual market watch pages, macros for regular tasks, and the ability to construct and produce (and reproduce) reports are all a major help. To make the most use of the database, it is also useful for data to be exportable, ie passable to the central bank's PC network for more complicated applications.

The main points to consider when comparing systems are cost, accuracy of data, speed and availability and reliability. Cost considerations will probably mean that the central bank concentrates on a few sources, perhaps even just one system, and it is important therefore to choose the right ones.

Accuracy of data is also important. For static details (eg bond issue sizes, maturity dates, etc), total accuracy is possible, and any system that cannot guarantee this is seriously flawed. Accuracy of price and yield data is more difficult; even the best services are likely to contain some errors, simply because of the volume of data entered each day. Unfortunately, a wrong data item does not just affect that day's readings; it also corrupts any averages that the system calculates, as well as any graphs. Of crucial importance therefore is how quickly the supplier of the service responds to calls alerting them to errors. The best suppliers will encourage users to ring them to point out errors, and (more importantly) will then correct their database.

Speed is also important. This covers both response time to a request from the keyboard and also speed of updating the system for new developments. Response time is critical, as anyone who has sat in front of a blank screen waiting for information to flash up will readily confirm. Anything more than about 5 seconds should be considered unacceptable, especially if it is information needed while the portfolio manager is on the telephone to a counterparty. Speed of updating the system is less critical but still worth considering; at the very least yesterday's closing levels must be available when the market opens up the next morning.

Availability and reliability are connected issues. Most systems these days are wire services, supplied by a fixed link. For these, the cost of the link will usually be included in the monthly rental and the main questions are the speed of response and the system's reliability.

Another factor to consider is whether the system requires the use of special or proprietary terminals, screens and keyboards. Although hardware rental is usually included in the monthly fee, such systems create other problems both in their maintenance and also in finding room for the extra boxes on the portfolio managers' desks!

The future outlook for one's own portfolio

This will probably be the last area to be computerised if resources are limited. Nevertheless an ability to look into the future can be a powerful aid to managing a portfolio, and can in particular highlight areas and strategies that are more risky than others, enabling investment managers to judge whether the likely return is worth the extra risk. In considering computer support in this field, one should look for a system that includes horizon analysis, future cash flow analysis (especially important for money market liquidity funds), what-if scenarios, and portfolio optimisation routines. All of these will require a link into the current portfolio positions, and are therefore likely to be an in-house system connected to (or indeed part of) the main portfolio support package.

To run this part of the computer support package some sort of matrix pricing routine will be needed, preferably linked to a yield curve generator model, as will the ability to create multiple notional portfolios and to price them and calculate their returns. Finally, though it is not so essential, it is worth including a facility to store scenarios for later comparison with actual events.

The future outlook for the market

This will always be an area where computers play a relatively minor role. Nevertheless there may be some scope for using a computer, for example in making predictions based on chartist analysis and trends, Elliot wave theory and other such technical applications. Other uses for a computer in this field will largely be restricted to mailbox-type facilities for market comment and predictions; whether a computer is any more use than a crystal ball here is for individual portfolio managers to judge for themselves.

SELECTED BIBLIOGRAPHY

There is a very wide range of books on investment management, and an equally wide range of books on bond mathematics. For the latter, the following may be of interest:

Forthcoming **Bank of England CCBS handbook** "Basic Bond Analysis". To obtain a copy see www.bankofengland.co.uk/ccbs/ccbshand.htm

On the specific subject of reserves management, a seminal work is:

Blackman, Dr Courtney "Managing foreign exchange reserves in small developing countries", published by the Group of 30 as Occasional Paper No 11, 1982.

Two more recent expositions of the issues are given by:

Cassard, Marcel and David Folkerts-Landau "Risk Management of sovereign assets and liabilities", IMF Working Paper WP/97/166, 1997. Has an extensive bibliography attached. Contact www.imf.org

Greenspan, Alan "Currency reserves and debt". paper given to the World Bank Conference on reserves management, Washington DC, April 1999. See www.bog.frb.fed.us/boarddocs/speeches/1999/default.htm

For a further discussion look at:

Nugée, John "The use of external managers in central bank reserves management", in the Hong Kong Monetary Authority Quarterly Bulletin, Issue number 8 (August 1996). See www.hkma.gov.hk

For a consideration of the optimal duration of reserves, look at the following paper:

Ilmanen, Antti "Does duration extension enhance long-term expected returns?", Salomon Brothers technical fixed income research, July 1995. Contact the author direct at Salomon Smith Barney for a copy, address antti.ilmanen@ssmb.com

Several central banks describe their reserves management practices in detail in their annual reports. The following list is by no means exhaustive:

Reserve Bank of Australia www.rba.gov.au

Hong Kong Monetary Authority www.hkma.gov.hk

Reserve Bank of New Zealand www.rbnz.govt.nz

Handbooks in this series

The CCBS has continued to add new titles to this series, initiated in 1996. The first 14 are available in Russian, and the first eleven in Spanish.

1 Introduction to monetary policy
2 The choice of exchange rate regime
3 Economic analysis in a central bank: models versus judgement
4 Internal audit in a central bank
5 The management of government debt
6 Primary dealers in government securities markets
7 Basic principles of banking supervision
8 Payment systems
9 Deposit insurance
10 Introduction to monetary operations
11 Government securities: primary issuance
12 Causes and management of banking crises
13 The retail market for government debt
14 Capital flows
15 Consolidated supervision
16 Repo
17 Financial Derivatives
18 The Issue of Banknotes

Handbooks: Lecture series

As financial markets have become increasingly complex, central bankers' demands for specialised technical assistance and training has risen. This has been reflected in the content of lectures and presentations given by CCBS and Bank staff on technical assistance and training courses. In 1999 we introduced a new series of *Handbooks*: *Lecture Series.* The aim of this new series is to give wider exposure to lectures and presentations that address topical and technically advanced issues of relevance to central banks. The following are available:

1 Inflation Targeting: The British Experience
2 Financial Data needs for Macroprudential Surveillance - What are the key indicators of risks to domestic Financial Stability?

All CCBS Handbooks can be downloaded from our website www.bankofengland.co.uk/ccbshand.htm

BOOKS

The CCBS also aims to publish the output from its Research Workshop projects and other research. The following is a list of books published or commissioned by CCBS:-

Lavan Mahadeva and Gabriel Sterne (eds) (October 2000): *Monetary Frameworks in a Global Context,* Routledge. (This book includes the report of the 1999 Central Bank Governors symposium and a collection of papers on monetary frameworks issues presented at a CCBS Academic Workshop).

Liisa Halme, Christian Hawkesby, Juliette Healey, Indrek Saapar and Farouk Soussa (May 2000): *Financial Stability and Central Banks: Selected Issues for Financial Safety Nets and Market Discipline*, Centre for Central Banking Studies, Bank of England*.

E. Philip Davis, Robert Hamilton, Robert Heath, Fiona Mackie and Aditya Narain (June 1999): *Financial Market Data for International Financial Stability*, Centre for Central Banking Studies, Bank of England*.

Maxwell Fry, Isaack Kilato, Sandra Roger, Krzysztof Senderowicz, David Sheppard, Francisio Solis and John Trundle (1999): *Payment Systems in Global Perspective*, Routledge.

Charles Goodhart, Philipp Hartmann, David Llewellyn, Liliana Rojas-Suárez and Steven Weisbrod (1998): *Financial Regulation; Why, how and where now?* Routledge.

Maxwell Fry, (1997): *Emancipating the Banking System and Developing Markets for Government Debt,* Routledge.

Maxwell Fry, Charles Goodhart and Alvaro Almeida (1996): *Central Banking in Developing Countries; Objectives, Activities and Independence*, Routledge.

Forrest Capie, Charles Goodhart, Stanley Fischer and Norbert Schnadt (1994): *The Future of Central Banking; The Tercentenary Symposium of the Bank of England*, Cambridge University Press.

*These are free publications which are posted on our web site and can be downloaded.