Managing Market Risk in Banks

Analysis of banks' risk exposures is important both for management within banks and for bank supervisors. Two major sources of risk for banks are credit risk (the risk that loans will not be repaid) and market risk (the risk of losses arising from adverse movements in market prices). This article focuses on the analysis and management of market risk, an area that has received increasing attention from managers and supervisors in recent years as banks' financial trading activities have grown. The article is based on a series of seminars held in the first half of 1996 by the Bank Supervision Department with participants from the banking and finance industry.

Measuring Risk in Trading Portfolios: Value at Risk

Much of the debate in recent years concerning the management of market risk within banks has focused on the appropriateness of so-called Value-at-Risk (VaR) models. These models are designed to estimate, for a given trading portfolio, the maximum amount that a bank could lose over a specific time period with a given probability. In this way they provide a summary measure of the risk exposure generated by a given portfolio. Draft guidelines[1] released by the Reserve Bank in August 1996 give banks the option (subject to supervisory approval) of using VaR models to measure market risk on traded instruments in determining appropriate regulatory capital charges.

VaR models can be developed to varying degrees of complexity. The simplest approach takes as its starting point estimates of the sensitivity of each of the components of a portfolio to small price changes (for example, a one basis point change in interest rates or a one per cent change in exchange rates), then assumes that market price movements follow a particular statistical distribution (usually the normal or log-normal distribution). This simplifies the analysis by enabling a risk manager to use statistical theory to draw inferences about potential losses with a given degree of statistical confidence. For example on a given portfolio, it might be possible to show that there is a 99 per cent probability that a loss over any one-week period will not exceed, say, $1 million.

Elaborations to basic VaR models can allow for correlations between different components of a portfolio by modelling the extent to which prices in different markets tend to move

1. The draft guidelines are closely modelled on the market risk proposals issued by the Basle Committee on Banking Supervision in January this year. They are due to be implemented in December 1997.

together; in this way the method takes into account possible effects of portfolio diversification. Still further elaborations permit the measurement of more difficult aspects of risk such as the liquidity of the instruments making up the portfolio. Here the issue is the ease with which an institution can liquidate or close risk positions. For some instruments (such as US or Australian government securities) large parcels can readily be sold at prevailing market prices. This might not be the case, however, for that part of the portfolio comprising relatively poorly traded securities. Standard VaR methods take no direct account of this, although it can be indirectly taken into account by the choice of the portfolio holding period: the more illiquid the portfolio, the longer the holding period that should be applied and, hence, the more susceptible it will be to price changes. Leading international banks have begun to model these liquidity effects in more detail and incorporate them directly into their VaR models, although this work is still at a relatively early stage.

Closely related to the approaches described above (known as parametric VaRs) are those based on simulation of portfolios using historical price data. The main difference is that instead of using summary sensitivity measures, or relying on statistical theory to enable inferences to be drawn about possible price movements (as described above), the simulation method takes a more direct approach. It takes a given portfolio, revalues it directly at current and previous market prices measured over a given time period, and then takes the more extreme observations – the large simulated losses – as indicative of what theoretically could be lost on the portfolio.

Conceptually, the same or very similar results should be delivered by the two approaches, as long as the underlying assumptions of the parametric VaR are valid. In this regard the key assumption is probably that market prices are generated from a normal distribution. In fact, there is strong evidence that large changes in market prices tend to occur more frequently than predicted by a normal distribution.[2] For example, statistical theory does not tend to predict price movements of the size seen in the 1987 share market collapse or in the bond markets in 1994. This violation of the statistical assumptions is a potential source of inaccuracy in parametric VaRs. In contrast, the simulation approach is considered to be more accurate but is much more computationally demanding. It requires extensive daily calculation of simulated portfolio values using daily market price changes recorded over periods of a number of years.

Proponents of VaR approaches point to the benefits of being able to summarise, in a single figure, an estimated level of risk faced by an institution from its trading activities. There is no doubt that this characteristic makes VaR models a powerful management tool. The obvious qualification is that by its nature, such a summary estimate does little more than provide a bank's higher management with a guide to the size of potential losses and their expected frequency in normal circumstances.[3] A comprehensive risk management approach requires that these methods be supplemented by an effective stress-testing program, to examine methodically the potential impact of extreme market events or scenarios. Ultimately, it is these abnormally large price movements that pose the greatest risks to financial institutions, not those calculated by the typical VaR model.

VaR methods have a number of shortcomings in dealing with large price movements. It is recognised that the models do not address all types of risk well (for example, risk associated with options where

2. In the risk literature, this is referred to as the problem of fat-tailed distributions. That is, there tends to be a larger number of extreme observations at the tails of the distributions than is implied by the statistical theory of normal distributions.

3. On average, for example, risk estimates based on a 95 per cent confidence interval will be exceeded once every 20 trading days. Using a 99 per cent confidence interval reduces the uncertainty but still suggests that estimates of risk will be exceeded on average 2 or 3 times a year (assuming a normal distribution).

the relationship between an underlying asset price and the associated option price is not linear). Most users of VaR models also recognise that reliance on estimated correlations across products and markets, while producing theoretically more accurate measures of risk, requires that those relationships between prices and markets remain stable, even at times of market disruption. Historical evidence suggests that this might not always be the case. There is a strong view that, for stress-testing purposes at least, it may be desirable to assume that all correlations break down in order to calculate risk estimates under worst-case assumptions.

These problems lead many institutions to rely on scenario-based approaches, where portfolios are routinely subjected to a wide range of hypothetical price and volatility movements. Advocates of this approach tend to downplay the benefits of a single VaR estimate, arguing that it obscures the potential impact that different configurations of prices might have on a portfolio.

Finally, it is recognised that any risk management system must be understood by, and consistent with, the activities of the risk takers themselves – those on the dealing desks. Effective risk management systems are not solely about restricting risks taken by trading staff (though that is obviously important). They need also to be behaviour-altering in the sense that the process of identifying, measuring and reporting risk fosters a mentality of risk awareness throughout the institution. This can be achieved by ensuring that, while the risk management function within an institution is independent of trading activities, risk managers do not become too divorced from the risk takers – that they understand trading activity and culture and are alert to the risk control issues that can arise within a dealing environment.

Non-Traded Interest Rate Risk

A second and often larger source of market risk for banks is non-traded interest rate risk. This source of risk is a direct consequence of banks' role as intermediaries. Banks carry a wide mix of both fixed-rate and floating-rate assets and liabilities on their books, many of which are subject to repricing when interest rates change. For example, a balance-sheet structure with predominantly short-term liabilities and long-term fixed-rate assets would be subject to losses when interest rates rise; a balance sheet with the reverse configuration would incur losses when rates fall.

The asset and liability management process which takes place within banks is, in part, about the determination of the interest rate sensitivity of the balance sheet and the implementation of risk management practices to hedge the potential effects of interest-rate changes. This is a quite separate matter from the analysis of any credit risk on the balance sheet (the risk that counterparties may default). The increasing complexity of bank products, and especially the degree of optionality being introduced into retail and wholesale products has heightened the complexity of risk measurement.[4] For these reasons, and given the potential size of these balance-sheet risks, banks have begun to devote significant resources to this area.

Approaches to balance sheet management

The traditional focus of asset and liability management has been the identification of maturity mismatches between assets and liabilities. An imbalance of assets over liabilities (or vice versa) over particular time

4. Optionality arises in balance sheets when products are offered which allow the institution or the customer to exercise some right in the future relating to the pricing, term or some other feature of the instrument; for example, the right of early repayment.

periods is said to give rise to a net asset or liability position. This could be offset or hedged by writing new liabilities or assets with a similar maturity or repricing profile. Mismatches arising from a bank's mix of business activities could also be offset by transactions conducted in the futures or derivatives markets. This would ensure that any losses incurred on the balance sheet from interest-rate changes would be offset by gains from positions in those other markets. Alternatively, any risk generated out of a balance-sheet mismatch position could, as a management decision, be left uncovered, opening the bank to potential loss or gain in the event of rate changes.

Analysis of this type (known as gap analysis) is still widely used within the banking system, but it is regarded as giving only an imprecise picture of interest-rate risk on the balance sheet. It has come to be supplemented, increasingly, by simulation analysis. This involves detailed forecasting of the entire balance sheet (typically for two or more years ahead) and subjecting all the forecast cash flows making up the balance sheet to a variety of price shocks, which may involve parallel shifts, twists or rotations of the yield curve. The resulting potential exposures are then measured, often in terms of their impact on the bank's net interest income. With this information at hand, balance-sheet strategies can be put into place and interest-rate risks hedged (or not hedged) as required.

Stabilisation (or steady growth) of a bank's net interest income is often viewed as a goal of asset and liability management. However, it is also a relatively narrow and short-term focus, particularly given the relative growth in non-interest forms of revenue in banks. Hence, the leading banks in this field have come to look at balance-sheet management against much broader criteria – one of the most common being the maximisation of the overall economic or market value of the institution. The central premise underlying much of this newly emerging analysis is that a bank's balance sheet is in essence a collection of current and future cash flows. Some represent principal flows, while others represent interest or non-interest cash flows. In theory, many balance-sheet components could therefore be marked to market in the same way that the price of a simple financial instrument can be readily re-estimated using market information. The management issue for the bank becomes the extent to which the market value of the bank (which is equivalent to the market value of its capital) can or should be insulated from the effects of possible interest-rate changes.

Such an approach carries a number of implications. Any decision to mark the entire balance sheet to market would, in all likelihood, introduce greater volatility into balance-sheet measurements, just as it does when applied to traded financial instruments. The more traditional accrual-based measurement systems, in contrast, tend to dampen the effects of price fluctuations and spread them over time. One issue is whether greater volatility in the economic value of the bank, if publicly disclosed through financial statements, would affect share prices, which might also tend to be more volatile. What would be the implications for investors in the bank? These are some of the issues which are being debated under the broad heading of balance-sheet management.

Behavioural characteristics of assets and liabilities and the treatment of capital

Some of the most complex issues in balance-sheet management relate to the treatment of assets or liabilities which have no formal repricing dates or where actual repricing behaviour differs from contractual repricing dates. For example, banks' current deposits in theory have no repricing date as they are repayable at call. Yet, analysis of the actual behaviour of current accounts shows that only a small proportion tend to be quite interest-rate sensitive while the remainder exhibit little such sensitivity. This means that some part of a bank's current-account balances (those which are interest rate insensitive) actually behave very much like fixed deposits and so could notionally be considered as fixed liabilities. As such, they would be effective hedges against some fixed assets. Those which

are highly sensitive to interest rate changes, by similar logic, would not be suitable to hedge a bank's fixed assets. The leading banks in the area of balance-sheet management are seeking to analyse precisely the behaviour of current accounts and determine the extent to which they can be categorised into core (or 'sticky') and non-core (more volatile) components for the purposes of interest-rate risk measurement.

On the asset side of the balance sheet, early loan repayments can open unexpected interest-rate positions on the balance sheet. In Australia, in contrast to the US, banks' policy is to charge fees to compensate for the effects of early repayment, though in practice such fees are often waived in the face of competitive pressures. As a result, the more advanced banks are analysing closely the behaviour of customers in order to improve their ability to monitor and manage this source of risk.

One of the most contentious issues in the area of balance-sheet management concerns the treatment of capital. Capital serves as a buffer against potential losses within a bank and is a means of funding the asset side of the balance sheet. But it is also a scarce resource on which banks must generate an acceptable rate of return for the owners. One of the most complex and undecided conceptual issues in balance-sheet management is how to reconcile those different roles played by a bank's capital. In practice a variety of approaches is adopted. Some banks leave capital out of the calculation entirely and focus only on the repricing behaviour of assets and tangible liabilities. Some take capital into account by focusing on its dividend stream, equating it to the return on other, more traditional, liabilities. Banks are still exploring these issues and no clear view has emerged on the appropriate approach.

Although work in the area of asset and liability management has been perceived in the past as less glamorous than other areas, that perception seems to be changing as the significance of this area of risk management for banks' overall performance is more widely recognised. The measurement and treatment of interest rate risk on the balance sheet is also likely to become an increasing focus of international supervisory attention over the next few years.

Integration of Risk Management and Capital Allocation

The increasing focus within banks on the management of market, credit and other risks in recent years has had two additional consequences:

- a tendency for much greater integration of risk management efforts within banks and the application of similar techniques across the different types of risk; and
- greater focus on the cost and allocation of capital, measured in true 'economic' terms, across the various business activities of a bank – the ultimate objective being the development of risk-adjusted performance measures for individual business lines and for the bank as a whole.

Until recently, use of statistical approaches in risk management was restricted largely to the measurement of market risk. Banks have come to recognise, however, that there is little conceptual distinction between market, credit and indeed other types of risk – all subject an institution to the possibility of loss. Banks are therefore beginning to look at using the measurement tools developed for the management of market risk more widely. For example, modern approaches to credit analysis are aimed at supplementing traditional judgmental approaches, where practicable, with more objective estimates of probabilities of loss on exposures. Some of this work has been assisted by improvements made to risk-grading systems over recent years.

These methods are also being adapted to the allocation of market-based capital within banks. Until very recently, analysis by banks of their own capital requirements was driven mainly by the capital framework outlined in the 1988 Basle Accord. Improved techniques have led, however, to reassessments of actual

capital needs by banks, both at the aggregate and disaggregated business levels. A number of Australian banks are now routinely estimating capital requirements based on the perceived economic need for capital in the various business units, not necessarily the amounts specified by bank supervisors. Here the focus is not only on the possible short-term losses that might be incurred (as typically estimated through the use of VaR or comparable methods), but also on the institution's own view of the losses it could reasonably sustain over a long period of time. That process of allocating capital has focused attention on the risk-adjusted performance of banking activities. Analysis of this type has even spilled down to issues associated with remuneration practices within institutions, with salaries and bonuses being considered not only against profits achieved but also the risks taken to earn them.

The calculation of 'economic' capital requirements is still in its infancy in Australian banks but will become more important over time, especially as banking becomes more competitive and increased focus is directed to returns on risk-adjusted capital. Such trends have implications for the evolution of current regulatory-capital requirements, including the extent to which banks' own capital allocation models might be viewed as acceptable as a basis for the calculation of regulatory capital. As outlined above, this process has already begun with the release of the market risk guidelines.

Conclusion

There is no doubt that risk management has become increasingly complex not only in relation to financial trading activities but also in relation to the risk found on traditional bank balance sheets. Risk management is therefore becoming a much more skilled activity than in the past. Much has also been made of the challenges posed by the quantitative developments in risk management, but it is equally important not to underplay the significance of more practical issues. The failure of Barings in early 1995 and the circumstances surrounding the discovery of large trading losses at Daiwa in NewYork later in that year, as well as the more recent experience of losses at Sumitomo, show that risk management must be made to work in practice as well as in theory. The ongoing task for banks' management, and for bank supervisors, is to ensure that those involved in risk-management activities are alert to potential operational deficiencies and act quickly to rectify any that exist.