The Reserve Bank's capital adequacy framework

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The Reserve Bank's operations involve a variety of financial risks, which influence the appropriate amount of capital the Bank should hold. This article outlines some of the approaches used to help formulate advice on the Bank's capital needs. Recent innovations have been designed to reduce the pro-cyclicality of those estimates, and to encompass a wider range of risks.

1 Introduction

The Basel Committee on Banking Supervision (BCBS) sets standards for the capital adequacy of commercial banking groups. These standards apply to international banking groups headquartered in BCBS member countries, but they have been adopted much more widely as they are recognised as international best practice. In its prudential supervision of registered banks in New Zealand, the Reserve Bank imposes capital adequacy requirements that are broadly in line with the Basel standards.[1]

The BCBS has significantly strengthened its capital adequacy framework in recent years in light of the global financial crisis, by issuing the documents known as "Basel 2.5" (BIS, 2011a) in 2009 and "Basel III" (BIS, 2011b) in 2010. These build on the so-called "Basel II" (BIS, 2006), which contains many of the central principles of the BCBS's current approach to capital adequacy.

In managing its own capital adequacy the Reserve Bank is not subject to regulatory capital requirements, but keeps abreast of regulatory requirements and banking industry best practice, as approaches to risk and capital modelling evolve. In particular, the Reserve Bank has adopted various components of the most recent BCBS developments as appropriate, while running additional methods tailored to fit its own balance sheet.

The Reserve Bank's balance sheet reflects its policy needs and objectives, and is rather different from those of commercial banks. Nevertheless, the Reserve Bank is subject to some of the same risks as commercial banks, namely market risk (profit or loss arising from changes in interest rates and foreign exchange rates), credit risk (arising from financial market derivative contracts and debt investments), and operational risk. Section 2 of this article explains the composition of the Reserve Bank's balance sheet and the risks it gives rise to, and the reasons why the Reserve Bank needs adequate capital to manage those risks.

Section 3 of this article outlines the Reserve Bank's approach to financial risk measurement. The section defines both market and credit risk, describing the processes and methods used to allocate capital to these risk factors, including enhancements drawn from recent BCBS changes. This risk-based capital allocation is analogous to the regulatory capital requirement that a commercial bank is required to calculate.

Section 4 explains how the Reserve Bank considers whether to add an additional capital overlay or buffer on top of its risk-based capital calculation. It does so using a set of forward-looking stress tests, to assess whether the results of the risk-based capital modelling are adequate. As at other institutions, the Reserve Bank uses the term 'economic capital' to describe the total amount of capital the organisation proposes to hold, including any buffer.

Section 5 concludes.

2 The Reserve Bank's balance sheet risk profile

The Reserve Bank's capital is provided by the New Zealand Government, and under the Reserve Bank of New Zealand Act 1989 (the Act), the Reserve Bank makes annual dividend payments to the Crown. The Act (section 162) requires the Reserve Bank to recommend to the Minister of Finance the amount of the dividend to be paid, and to do so in accordance with principles set out in the Reserve Bank's annual *Statement of Intent* (SOI) (RBNZ,

[1] The details are available at http://www.rbnz.govt.nz/regulation_and_supervision/banks/banking_supervision_handbook/

2013). The dividend principles in the SOI are:

- The Bank should maintain sufficient equity for the financial risks associated with performing its functions. Equity in excess of that required to cover those risks will be distributed to the Crown.
- In general, unrealised gains (profits) should be retained by the Bank until they are realised in New Zealand dollars. However, the Bank may recommend the distribution of unrealised gains where the Bank believes that the probability of the gain being realised is high.

Given this accountability, and policy commitments under the Act, the Reserve Bank aims to maintain adequate capital to support its functions and commitments while minimising the possibility that balance sheet risks could cause it to run short of capital and report negative equity. This article outlines how the Reserve Bank reaches a view on what that 'adequate capital' is.

(Negative equity would have quite different implications for the Reserve Bank than for a commercial bank. It would still be able to carry out its day-to-day functions,[2] but having negative or low reported equity could undermine the institution's credibility, and – in a worst case scenario – potentially diminish its ability to implement policy.)

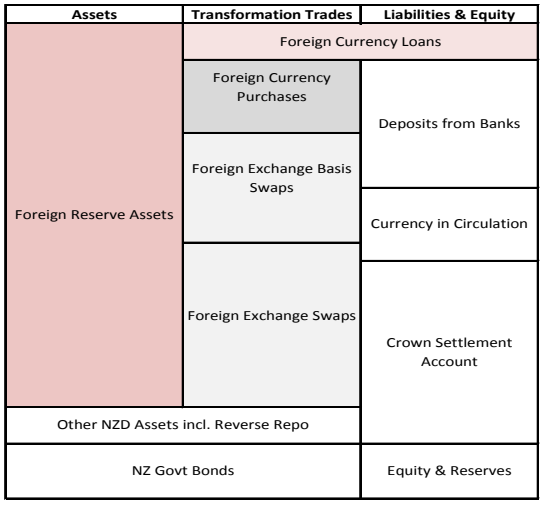
Viewed from a financial risk management perspective, the Reserve Bank's key facilities are its New Zealand Dollar (NZD) liquidity operations that support monetary policy and New Zealand's money markets, and its portfolio of foreign reserve assets that can be used to finance market intervention, including FX intervention, to support monetary policy and/or reduce market dysfunction.

Figure 1 includes a stylised picture of the Reserve Bank's balance sheet. This broadly illustrates the relative composition of the Reserve Bank's assets and liabilities in the 2012/2013 financial year, and the 'transformation trades' that the Reserve Bank uses to transform the balance sheet to achieve its strategic composition of asset and foreign currency positions.

The illustration highlights three key elements: the dominance of the foreign reserve assets portfolio (foreign reserve assets); a large and variable foreign currency position (foreign currency purchases);[3] and the use of foreign exchange swaps to transform NZD liabilities into foreign currency funding (without taking on additional foreign exchange risk).[4]

There are also two key internal policy decisions that vary the risk impact of these three balance sheet elements: the aforementioned strategic composition of assets and foreign currency positions; and the Reserve Bank's counterparty credit policy that controls the level of credit risk arising from the foreign exchange swap portfolio.

Figure 1
Stylised Reserve Bank balance sheet



Strategic Asset Allocation

As the Reserve Bank needs to maintain its crisis intervention capability at all times, it holds its 'core' foreign reserves assets in markets and instruments that demonstrate deep liquidity under all market conditions. This choice of instruments and currencies is collectively referred to as the Reserve Bank's Strategic Asset

[2] A central bank is often able to operate 'normally' despite negative equity, as seigniorage can be used to recapitalise it through time. The long-term nature of seigniorage-related income finds seigniorage sometimes referred to by central banks as 'shadow capital'.

[3] The Reserve Bank has a policy of maintaining a portion of its foreign reserves on a currency unhedged basis (unhedged foreign reserves). The size of this position largely depends on the Reserve Bank's exchange rate intervention operations, where buying (selling) NZD would result in a decrease (increase) in the unhedged foreign reserves. (See Eckhold (2010a) and Eckhold (2010b) for more details.)

[4] The majority of foreign reserves, in the illustrated example, are funded by NZD denominated liabilities. A portfolio of foreign currency loans from the New Zealand Debt Management Office makes up the remainder.

Allocation (SAA).[5]

Figure 2 outlines the Reserve Bank's current SAA across the six major sovereign debt and currency markets to which core reserve assets are allocated. The sovereign debt allocation determines the Reserve Bank's target mix of sovereign debt instruments, while the foreign exchange allocation determines the composition of the Bank's foreign currency position. Bonds and bills are differentiated in this process, as they have different duration and liquidity characteristics.[6]

As the SAA determines a large part of the Reserve Bank's balance sheet composition, it has a high impact on the risk profile of the balance sheet. It drives in particular:

- the credit risk the Reserve Bank faces in holding debt obligations (bills and bonds) issued by selected governments;
- the interest rate risk arising from the purchase of fixed rate debt obligations (where bonds have a longer duration than bills and as a result generate greater interest rate risk); and
- the characteristics of the foreign exchange risk arising from the Reserve Bank's foreign currency position.

Figure 2
The current SAA

Sov. Debt	Bills	Bonds	Foreign Ex.	
USA	36.5%	7.5%	USD	25%
Europe	12.5%	5.0%	EUR	25%
Japan	8.5%	6.5%	JPY	5%
UK	7.0%	2.1%	GBP	15%
Canada	6.5%	3.5%	CAD	10%
Australia	0.0%	4.4%	AUD	20%
Total		100.0%	Total	100%

Counterparty credit risk policy

The Reserve Bank maintains a portfolio of derivative contracts, including foreign exchange swaps and 'reverse repos' (securities purchase and resale agreements). These are the 'transformation trades' shown in figure 1. Each of these contracts exposes the Reserve Bank to the creditworthiness of the counterparty to the trade, for as long as it is outstanding.[7] These include trades associated with the provision of NZD liquidity facilities for New Zealand's registered banks. To keep levels of counterparty risk low, the Reserve Bank requires counterparties to provide collateral to mitigate credit exposures as they arise, and continuously vets the banks with which it transacts. This credit risk management process includes a credit scoring system that is not unlike those run by credit rating agencies, but with a greater emphasis on market indicators, such as credit spreads. Exposure limits are set for these counterparties depending on their credit score.

3 Risk-based capital methodology

The Reserve Bank's capital adequacy framework ensures that its capital is adequate to support its functions and commitments. The framework minimises the possibility that balance sheet risks and/or financial market conditions could cause the Reserve Bank to run short of capital and report negative equity. This is a continuous process which chiefly involves the monitoring of daily Value at Risk (VaR) numbers and measures of operational risk. However, the Reserve Bank's risk management team also monitors its asset and liability portfolios in light of market activity on an on-going basis.

These processes ensure that the Bank is unlikely, over certain specified time periods,[8] to suffer a financial loss through credit, market or operational risk that would result in negative equity.

The processes for assessing the potential loss from credit, market and operational exposures are different from one another, and accordingly are discussed separately in the following.

[5] Foreign currency investments (or foreign reserves) raised and funded through domestic market liquidity operations are not deemed 'core' reserves. Rather than being diversified into SAA specified markets, these reserve assets, which tend to be short-dated in nature, are predominantly invested in USD denominated supra-nationals and government agency debt.

[6] Bonds are generally more market liquid but also carry greater interest rate risk, depending on the target duration for bonds (as identified in the SAA modelling process).

[7] The exposure arising at any given time on such a contract is the amount (if any) that the counterparty owes the Reserve Bank under the contract, based on current market prices, and taking account of any collateral provided to the Reserve Bank. This it typically much less than the 'notional principal', that is, the reference amount of the underlying instrument(s) on which the contract is based.

[8] Various time periods are considered. VaR produced as part of the Bank's daily risk reporting processes is calibrated to test potential loss over one day (24 hours), while stress and capital models consider longer periods.

Market risk measurement

Market risk is the risk that the value of an asset or liability changes due to movements in the market variables that affect its pricing, normally foreign exchange rates, interest rates or yields, credit spreads, and basis spreads.[9]

As already noted in the balance sheet risk section, the Reserve Bank's principal market risks are foreign exchange and interest rate risk. These vary through time according to SAA decisions and the size of the Reserve Bank's foreign exchange position.

No matter the asset class, four key components drive the magnitude of the market risk arising from taking a position in a given instrument. These are the size of the position, the volatility of the factors affecting the instrument's pricing, the liquidity or holding period of the position, and, if the position is part of a portfolio, the correlation of factors across the portfolio, that is, the extent to which various factors move together.

The Reserve Bank uses Value at Risk (VaR) models to capture these factors and estimate the potential loss from holding a given portfolio for a specified period. (VaR is a statistical measure that uses historical market price data to estimate the maximum potential loss from holding a given portfolio over a certain time frame, normally one or ten days, to a certain degree of confidence, often 99 percent or 99.9 percent).

VaR models are used by the Reserve Bank both on a daily basis, as part of its routine risk management process, and to calculate risk-based capital.[10] VaR results not only estimate potential losses, but also give the Reserve Bank useful insight into the variability of the potential loss as less visible elements (namely factor volatility and correlation) change through time.

A critical component in the Reserve Bank's routine VaR computations is the liquidity of each position. In the context of market risk, liquidity is the expected time it takes to sell down or unwind a position or portfolio, and is typically measured in days. The Reserve Bank's core reserves, for example, are extremely liquid and could be sold down within one day if necessary, whereas its currency swap portfolio is less liquid, and would take longer to unwind or neutralise (if the need were to arise), potentially exposing the Reserve Bank to greater losses.

However, for determining risk-based capital for market risk, it is important for the Reserve Bank to consider the extent to which it would actually reduce its individual positions or portfolios, given its policy obligations and the circumstances at the time. For example, if faced with falling prices for US Treasury debt, the Reserve Bank might not act as quickly as a commercial bank to reduce its positions in those assets. Rather, the Reserve Bank would likely hold those positions in the short to medium term to maintain the strategic composition of foreign reserves. The Reserve Bank therefore needs to use holding period assumptions that take account not only of observations of actual market liquidity (such as market-wide trade volumes or market turnover), but also of how long the Reserve Bank expects that it would hold the positions in practice.

Holding periods (for each of the Bank's positions) are an influential factor in computing market risk capital, since they define the observation periods over which pricing factor volatility is measured.

The results of the market risk capital VaR calculations are included in figure 4 (overleaf).

The concept of 'stressed VaR' was introduced under Basel 2.5 during 2009, and was subsequently introduced in many jurisdictions outside New Zealand in 2011. The normal VaR method uses a 'trailing window' of input data, that is, the most recent historical data up to the calculation date. Regulatory capital based on the results of trailing window VaR is inherently pro-cyclical, in the sense that it is lower during periods when price volatility is lower: a bank that relies on this measure may therefore reduce its capital during such a period, and may then turn out to have insufficient capital to handle losses when volatility increases again. The stressed VaR approach was developed to help combat this pro-cyclicality in the trailing window approach.

The stressed VaR approach is a relatively simple enhancement of standard VaR, in that it uses essentially the same calculation methodology, but with different input

[9] Under the terms of a foreign exchange basis swap, for example, one party receives a fixed spread (throughout the life of the trade) known as the 'basis swap spread'.

[10] Both delta-normal and historical simulation models are used for risk-based capital calculations

data. Rather than using the trailing window of historical data, stressed VaR uses data from a fixed historical period over which the institution in question suffered particularly heavy losses from market price movements. For many commercial banks, this was the period immediately following the Lehman Brothers collapse on 15 September 2008.

By measuring market risk using the stressed VaR as well as the standard VaR approaches, the Reserve Bank can see the impact that elevated market volatility has on market risk, and is more aware of the historical scenarios which would be most disruptive for the current balance sheet.

Figure 3
Distribution of VaR and stressed-VaR simulation results

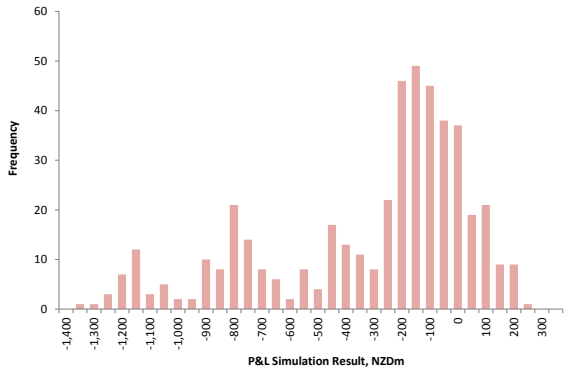


Figure 3 illustrates the distribution of the Bank's market risk VaR results using market data captured between October 2008 and April 2013. As the dataset includes the stressed period, which is selected to produce the most extreme possible losses, it is not surprising to see that the distribution is negatively skewed.

Credit risk measurement

Credit risk is the risk that a counterparty fails to meet a financial obligation, either defaulting on the obligation altogether, or making a deferred or discounted payment.

As noted in the balance sheet risk section above, the principal credit risks borne by the Reserve Bank arise from holdings of government debt instruments within the SAA, and counterparty credit exposures that arise from derivative transactions, or 'issuer risk' and 'counterparty credit exposure', respectively.

The Reserve Bank determines its capital allocation for credit risk using a modified version of the Basel II credit VaR approach.[11] The data inputs to this methodology include issuer risk positions, counterparty credit exposures, the probability of issuer or counterparty default, correlations between defaults across different counterparties and issuers, and the expected percentage of the exposure recovered in the case of issuer or counterparty default.

As with market risk, the Reserve Bank calculates credit risk capital using two different sets of input data: one drawn from a three year trailing window of the most recent historical data, and one drawn from a period of credit stress.

The Basel II credit VaR approach is relatively prescriptive about the credit risk factors to be used, with the exception of default probabilities. For these, the Reserve Bank, like other financial institutions, mostly uses historical default statistics published by the credit rating agencies. This approach allows the Reserve Bank to base default probabilities on actual default rates, rather than using default probabilities implied by market prices (which are, generally speaking, both higher and more volatile). This in turn provides a relatively stable capital result.

However, for counterparties with the strongest credit rating (AAA or equivalent), historical observations persistently give a one-year default probability of zero. And while the likelihood of an AAA-rated entity defaulting in any given year is certainly very remote (based on historical default rates), it is doubtful that the default probability is truly zero. Instead of using 0 percent, in the trailing window VaR calculation the Reserve Bank uses the Basel II stipulated minimum default rate of 0.03 percent, and in the stressed VaR calculation, uses one tenth of the cumulative ten year default probability for AAA-rated entities.[12]

[11] Basel III has adapted the Basel II capital requirements for counterparty credit risk (CCR) to include projected counterparty exposures using stressed factors. As the Reserve Bank does not take uncollateralised exposure to its commercial banking counterparties, the most useful aspect of Basel III CCR is the concept of stressing input factors.

[12] The credit risk models include a default probability for the New Zealand Government, but this is largely offset by high recovery rate assumptions for holdings of New Zealand Government debt. These assumptions reflect the New Zealand Government's role as the Reserve Bank's capital provider.

Combined risk-based capital

Figure 4 shows the outputs of the Reserve Bank's market and credit risk capital models using both standard VaR and stressed VaR. As the stressed VaR results are the largest, the stressed VaR results combine with the operational risk allocation to make up the Bank's risk-based capital requirement.[13]

Simply summing the capital needed for each risk, as in figure 4, implies an assumed correlation of 100 percent between the risks. In practice however, it is unlikely that all risk factors would crystallise at the same time: in other words, there are benefits from having a diversified portfolio. Indeed, summing the capital components listed in figure 4 using an 85 percent correlation assumption would give a $2,200 million capital requirement. However, as correlations tend to change significantly during financial crises, the Reserve Bank is generally cautious about correlation modelling and assumes the worst case (100 percent).[14]

Figure 4
Combined risk-based capital

Capital Model	Result (NZD)
Market Risk VaR	425m
Market Risk Stressed VaR	1,350m
Credit Risk VaR	350m
Credit Risk Stressed VaR	900m
Operational Risk	50m
Proposed Capital	**2,300m**

4 Stress-testing risk-based capital

To supplement VaR measures – which are historically bound in their use of historical volatility and correlation data – the Reserve Bank's stress-testing process aims to find hypothetical market and credit risk related scenarios that generate significant financial loss.[15]

In the context of the capital framework, stress testing is used to test the adequacy of risk-based capital. Where stress scenario results are found to exceed risk-based capital, the Reserve Bank's ALCO (Asset and Liability Committee[16]) will consider the case for establishing a buffer of additional capital. As these considerations relate to the results of hypothetical extreme events, the process is not prescriptive.

As part of reviewing its level of economic capital, the Reserve Bank has considered the results of four stress tests. Each of the four stress scenarios includes changes in credit risk, in the form of modified default probabilities, and in market risk, in the form of modified foreign exchange rates, interest rate spreads, and basis spreads. The main features of each stress scenario are as follows:

- Scenario (1) assumes a disruption to food supplies beyond New Zealand's borders, resulting in a sharp appreciation of the NZD against the currencies of all of New Zealand's main trading partners.
- Scenario (2) – a global supply or inflationary shock – pushes interest rates higher in all of the major markets in which the Reserve Bank holds its reserves. Such a shock could for instance be triggered by disruption to primary energy markets.
- Scenario (3) models the impact of elevated default probabilities and market volatility, triggered by a significant credit event in the financial or government sector outside New Zealand.
- Scenario (4) considers the market and credit risk repercussions of an international humanitarian crisis and/or displacement event, such as a bird-flu pandemic, or a major act of terrorism.

The Reserve Bank's risk management team presents the stress testing results to the ALCO alongside the VaR results, and in some instances where stress testing results are positive, replaces them with VaR results (which reflect losses). For example, in scenarios (3) and (4), credit risk losses are expected to be partially offset by a falling NZD exchange rate, which would generate mark-to-market profit for the Reserve Bank on its foreign exchange

13 Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. The Reserve Bank uses a Basel II standardised approach to quantify operational risk.

14 By historical observation, correlation between the Reserve Bank's interest rate risk and credit risk factors is high because of its large holdings of government and agency debt. However correlation between credit and foreign exchange risk is not so intuitive, and is heavily dependent on the observation period.

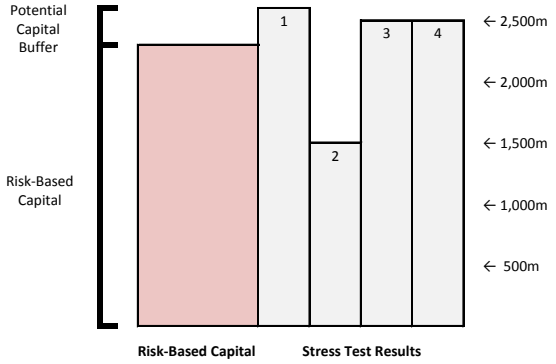
15 Although scenarios are forward-looking, many are calibrated to historical data. For example the NZD appreciation modelling in scenario (1) is calibrated in light of recent NZD appreciation (from early 2009).

16 ALCO is responsible for overseeing the risk management of the Reserve Bank's balance sheet, and related to that, makes recommendations on all decisions relating to its capital adequacy.

position. However, although NZD weakness is indeed the more likely market reaction as economic activity contracts under this scenario, it is possible that the NZD does not move significantly (or appreciates). In scenario (4) for instance, the NZD might be supported by demand for it as a relatively safe haven currency, depending on the countries affected by the incident and the relative demand for New Zealand assets or exports. In this instance the foreign exchange gains projected under the stress scenario are replaced by the potential loss calculated using the VaR model. In this way the Reserve Bank is careful not to rely on common presumptions about the correlations between different market variables, a factor that has proven over the years to be notoriously unpredictable.

Figure 5 illustrates each of the stress testing results alongside risk-based capital.

Figure 5
Risk-based capital and stress scenario results



The Reserve Bank's ALCO has chosen not to recommend a capital buffer on top of the increased amount of $2,300 million of risk-based capital. This decision was made on the basis that: only the most extreme stress scenarios produced losses sufficient to completely wipe out risk-based capital; the capital shortfall in these scenarios was relatively small and potentially sustainable and/or recoverable (through seigniorage); and in many circumstances the Crown would be able to inject capital as a last resort backer.

5 Conclusion

An advanced capital adequacy framework ensures the Reserve Bank remains appropriately capitalised consistent with its policy commitments and risk choices. Capital plays a different role in the Reserve Bank than in a commercial bank – where, for example, it is a key basis for performance measurement. However, as is the case at other financial institutions, the Reserve Bank must continuously question the effectiveness of its processes for identifying and measuring the risks that it faces, and the suitability of its underlying model assumptions.

The recent application of new risk capture methods has further enhanced the robustness of the Reserve Bank's capital adequacy framework. These new techniques reduce capital cyclicality and allow management to better understand both the market and credit conditions that the Bank is able to withstand, and those to which it is potentially vulnerable. The changes to the framework have in this way improved transparency.

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