

CONFIDENTIAL

9 February 2004

Hon Dr Michael Cullen
Minster of Finance
Parliament Buildings
WELLINGTON

Dear Dr Cullen

Foreign Reserves

Introduction

1. Under Section 24 of the Reserve Bank of New Zealand Act 1989, you are required, from time to time, in consultation with the Bank, to determine the appropriate level of foreign reserves.¹
2. Following a major review of the adequacy of our foreign currency reserves, we conclude that it would be prudent to increase the level of foreign currency reserves to be held by the Bank for the purposes of intervention in foreign exchange markets. This conclusion was reached with regard to the Bank's ability to restore liquidity in the foreign exchange market if and when the New Zealand dollar market becomes dysfunctional. As the Bank is also scheduled to discuss the related issue of our intervention strategy and alternative intervention policy options on the 4th of March, at this point we are only asking you to **note** our recommendation for an increase in foreign currency reserves. Following the meeting on the 4th of March, we suggest that we put an integrated package to you – for your **decision** – that includes the Reserve Bank's recommended foreign exchange strategy, an adequate level of foreign currency reserves, and the financing options for changing the level of reserves.
3. This letter first revisits why we hold reserves, and discusses the framework we used to assess an appropriate level of reserves holdings, in terms of the Section 24 determination. In this context, we recommend an increase in the level of our intervention portfolio. Treasury have been consulted in the preparation of this letter, and their views have been included.

¹ Although 'foreign reserves' are not defined in the Act, we consider foreign reserves to be the foreign currency assets that the Bank holds 'in reserve' for the purpose of any necessary future intervention in foreign exchange markets (our 'intervention portfolio'). Note that the Bank also often holds significant levels of foreign currency assets for purposes other than possible future intervention in foreign exchange markets.

Background

4. Between 1988 and 1998, successive Ministers of Finance agreed that the Bank should hold a target intervention capacity of around NZD 4.5 billion. In 1998, it was agreed that the intervention capacity should be stated in foreign currency terms, and that the appropriate range, measured in IMF's Special Drawing Rights (SDR) terms (as an international 'currency') was SDR 1.7 billion to SDR 2.0 billion.² In December 1998, this range was lowered to SDR 1.45 billion to SDR 1.75 billion, following the transfer of the IMF Reserve Position from the Bank to the Treasury.
5. The rationale for the shift to targeting the intervention capacity range in foreign currency terms was that any intervention in a crisis situation would involve the Bank acting as a supplier of foreign currency; hence it is the foreign currency amount that the Bank holds that is important. A crisis in this situation is one where there are no 'market makers' in the New Zealand dollar, and the Bank stands prepared to purchase New Zealand dollars using foreign currency reserves.
6. The Bank has undertaken an extensive research programme to determine what the appropriate, adequate, level of reserves is. This research programme included literature surveys, cross country studies, building a robust model that has been favourably reviewed by the IMF (as a part of the FSAP process), and discussions with the IMF and other central banks.³ On the basis of our work, our recommendation is for an increase in the level of foreign reserves. This recommendation is based on analysis that is predicated on our existing intervention policy – that is, that the Bank will intervene to avoid foreign exchange market dysfunction, or in extreme cases, breakdown. If the intervention policy were to change to a more activist policy, or were we to shift to a different approach to financing reserves then it may mean that the optimal level of reserves may be higher than the current recommendation.
7. Specifically, our analysis and recommendation assumes that we continue to finance foreign reserves by borrowing in foreign currencies. Another assumption is that our current approach to foreign exchange intervention remains the same. Changes to either of these two assumptions – for example, by shifting to a more interventionist policy, or by financing reserves by borrowing in New Zealand dollars (leaving the foreign exchange expose unchanged) – has implications for the appropriate level of foreign reserves. In particular, it is possible that the appropriate average level of reserves would be higher, and fluctuate through a significantly wider range through time, than the current recommendation.

² These numbers are consistent with a figure of around NZD 4.5 billion. The current conversion rate is NZD 1 = SDR 0.45.

³ This work is available on request. A summary of the model is appended to this letter, but it is important to stress that our recommendation is based on all of our analysis, not just the reserves model.

Why we hold reserves

8. No matter how high the standard of economic management and good the access to international financial markets, there may be situations where an extreme event could impact on the New Zealand foreign exchange market to the extent where New Zealand dollar liquidity was seriously eroded, and a dysfunctional foreign exchange market resulted. The 'cost' of a dysfunctional foreign exchange market is difficult to quantify, and will vary depending on the severity and nature of the event. For example, in some cases foreign exchange crisis can lead to, or at least be associated with, a banking sector crisis also. Our estimates of the cost to the economy from a currency and banking crisis range from 2 to 8 per cent of GDP. In such a situation, foreign exchange reserves would provide an important policy option. In a crisis situation, access to international financial markets will likely prove problematic and/or expensive, and intervention may well prove the best means by which to re-establish the New Zealand dollar market, thus minimising both the disruption to business and the nation's cost of capital.
9. The issue of appearances is also relevant. Creditor perceptions that all countries should have adequate foreign reserves, irrespective of whether reserves are necessary for growth and debt servicing capacity, provide a reasonably powerful incentive for New Zealand to hold reserves. This is especially so for New Zealand as some of the indicators that markets use to assess vulnerability – such as the level of external debt and the proportion of that debt that is short term in nature – look high by other developed country standards.
10. While there are benefits from holding reserves, there are also costs. There are fixed costs associated with holding reserves that average around \$3 million (this varies through time, and the current budget is for \$3.6 million for the year to June 2004). This includes staff salaries, equipment, access to information services such as Reuters and so on. There are also variable costs associated with holding reserves. We estimate this cost to be approximately NZD 750,000 per \$1 billion of reserves, essentially the difference between what it costs to raise foreign currency to invest in reserve assets and the rate of return on those highly liquid and safe assets themselves. Of course, we manage the reserves in such a fashion as to minimise the overall cost.
11. The net overall cost of holding reserves is relatively modest when compared to the potential cost of not having the capacity to intervene in adequate quantities when needed. One way to think about the issue is from a 'regret analysis' point of view – given the relatively cheap premium for insurance, how much would you regret not having enough (insurance) cover in times of crisis? A rule of thumb, for example, suggests a reasonable estimate of an insurance premium is 3 per cent of the capital value under threat. This is materially higher than the 0.15 per cent that the cost of holding an adequate level of reserves relates to.

The Target Level of Reserves (Section 24)

12. If we are to hold reserves, then we must hold a sufficient quantity with which to intervene and achieve our objectives. These objectives are to maintain liquidity in the New

Zealand dollar market, and to restrict movements in exchange rates that are due to the dynamics set up by liquidity problems (rather than to a shift in equilibrium exchange rates associated with the originating shock). Indeed, this is the main rationale for holding reserves, although another reason is to support investor perceptions about New Zealand's debt servicing capacity.

13. Estimating the precise amount required is difficult for several reasons, and will only ever be able to be quantified with the benefit of hindsight. Clearly, we have no recent history of intervention to draw upon, and there exists no generally accepted methodology for determining an adequate level of reserves, let alone an optimal level, that we can rely on. While we have developed a model that provides a useful framework for approaching the question of an adequate level of reserves that is well grounded in theory and empirics, judgements around the optimal – or adequate – level of reserves are necessarily as much art as science.
14. Adequate reserves provide a form of insurance against a disorderly or dysfunctional foreign exchange market; there is a positive probability of a crisis; when they do occur the cost of crises are large; and the 'insurance premium' (the cost of holding reserves) is relatively cheap. In essence, we weigh the costs of holding reserves against the expected benefits. The costs are well known and are largely determined by the level of foreign reserves and the difference between the costs of borrowing and investing. We estimate that the annual marginal cost of holding reserves is about \$750,000 per \$1 billion in reserves. It is worth stressing the concept of 'adequate' reserves when discussing the costs, as in a sense there is an asymmetry associated with the costs. For example, if the amount of foreign currency reserves we hold is insufficient to avoid foreign exchange market dysfunction, then the costs could be very large (somewhere between 2 and 8 per cent of GDP). If the amount of foreign currency reserves are sufficient then the costs – the holding costs and so on – are significantly less.
15. The benefits are conceptually simple, but somewhat more difficult to determine, however, they are determined by:
 - The probability of a foreign exchange crisis occurring;
 - The magnitude of the potential economic loss that could result;
 - The effectiveness of foreign exchange intervention in both restoring liquidity and reducing volatility; and
 - The risk preference of the policymaker.

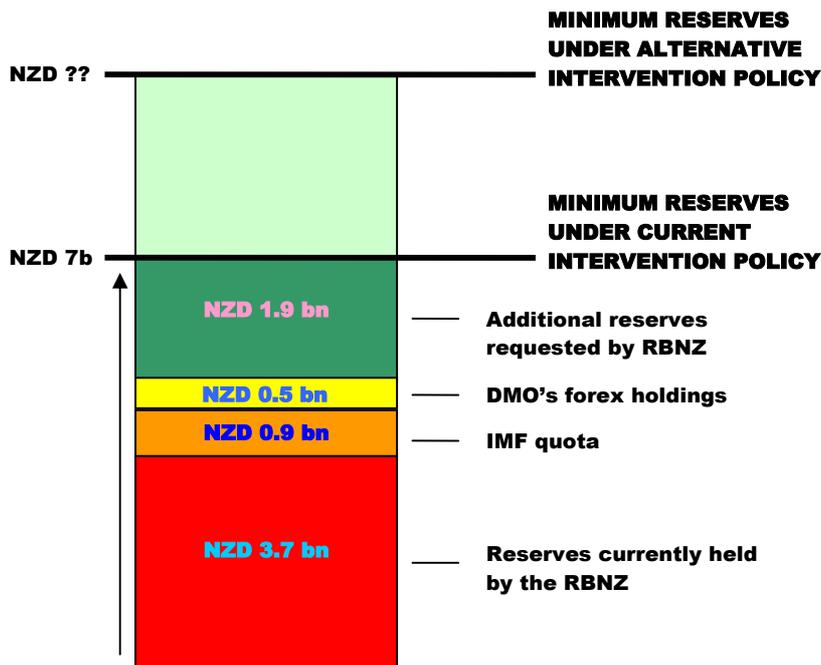
There are other, peripheral, benefits from holding adequate levels of reserves such as increased credibility in the eyes of investors, creditors, and rating agencies, but these are not specifically accounted for in our analysis.

16. While there are uncertainties around the 'optimal' level of foreign reserves the Bank should hold, we believe that it would be appropriate and prudent to increase reserves beyond the current target of SDR 1.45 billion to SDR 1.75 billion. We recommend that the target range be raised, in NZD terms, by NZD 3.3 billion from around NZD 3.7

billion to NZD 7 billion.⁴ However, there are alternative holdings that will likely be available in the event of a crisis and would help narrow the gap between the current reserves level and the level our analysis suggests that is likely to be required. These alternative assets and our recommended approach to financing an increase in our intervention capacity are discussed in the next section.

Sources and Funding

17. If reserves were to increase to reach the recommended level, they would need to increase by approximately NZD 3.3 billion from the current NZD 3.7 billion to 7.0 billion. However, we estimate that around NZD 1.4 billion of liquid foreign currency assets are already held by Treasury and would be available for use in a crisis situation. Thus, our recommendation implies that the Bank’s holding of foreign currency assets need to be increased by around NZD 1.9 billion.



⁴ This would lift the target range to 3 to 3.3 billion SDRs, which is equivalent to 6.7 to 7.3 billion New Zealand dollars, under the current specification. We would also want to clarify the technical specifications, including the width of the range and the composition at the point of re-negotiation.

18. The Treasury's NZD 1.4 billion of liquid foreign currency assets comprise New Zealand's reserve tranche position at the IMF of NZD 900 million, and NZD 500 million liquid assets that the Treasury believe could be accessed in times of crisis. The NZD 500 million amount is held to offset some long-term liabilities (and are collectively known as the 'defeasance portfolio') that will wind down over time. Our degree of comfort in counting the defeasance portfolio towards what we consider the adequate level of reserves would be conditional on the degree of certainty that the RBNZ is assured access to the portfolio in times of crisis. Treasury have indicated a willingness to work with the Bank on increasing the degree of certainty around access in times of crisis.
19. In the event of a foreign exchange crisis, the Bank has the capacity to draw down on an uncommitted credit line (of up to USD1 billion) from the Bank for International Settlements. While this line enhances our capacity to intervene when global financial markets are operating normally, uncommitted credit lines cannot be relied on in times of global financial stress. [] For these reasons, the Bank includes only high credit quality, liquid assets and committed credit lines with credit worthy organisations in determining intervention capacity.
20. In terms of the funding of additional reserves, from an economic perspective, an increase in the level of foreign reserves does not materially affect the level of net government debt because the debt raised will be invested in liquid foreign currency assets (which offsets the debt raised). Importantly, therefore, our recommendation has only minor implications for the government's fiscal situation as the funds raised will be saved not spent. But, the economic impact is a more secure insurance against potential currency crisis.
21. However, the increase in intervention capacity does imply an increase in gross crown debt, regardless of how the increase in reserves is financed. This, in turn, has implications for the management of any increase, such that it is consistent with government policy for the gross crown debt target ceiling of 30 percent of GDP. For example, our recommendation implies, all else equal, an increase in the Crown's gross debt-GDP ratio of around 1.2 percent (but no change to net debt).
22. While the Bank believes that there is a positive probability that a crisis could occur, we do not consider that a crisis requiring intervention in the foreign exchange market is likely in the near term. Therefore, an increase in reserves could be implemented over a few years – consistent with the government gross debt target policy. For example, the government could increase the Bank's intervention capacity by around NZD 500 million each year for the next four years. A gradual approach to increasing reserves has the additional advantage that it is less likely to affect the Crown's financing costs. The Treasury believe it is possible increase the Crown's debt programme by an extra NZD 500 million per annum without unduly affecting the Crown's finance costs.

Other issues: Alternative financing options and intervention goals

23. There are alternative ways to fund reserves. The Bank normally finances its reserves by borrowing in the foreign currencies that investments are held, thereby protecting the Bank

and the Crown from foreign exchange risk. This approach is consistent with the Crown's general preference to hold zero net foreign currency debt on the core Crown balance sheet. In addition, this approach provides the Bank with a clear benchmark (i.e. the actual costs associated with borrowing reserves) against which it can assess its reserves management performance. Our recommendation to increase intervention capacity assumes existing foreign exchange intervention and reserves financing policies continue to apply – that is, we assume that increased foreign reserves will be financed by foreign currency denominated debt.

24. However, it is common for central banks to borrow in their own currencies to finance their holdings of foreign reserves (the RBA, for example). When building up foreign reserves, these central banks will borrow in their own currencies, sell the funds raised for foreign currencies which are then invested as foreign reserves. The result is that these central banks are left with an exposure to foreign exchange risk (if their currencies appreciate then they take unrealised losses on their foreign reserves). However, while reserves are being built, the sale of domestic currency in the foreign exchange market may place some downward pressure on the exchange rate, at least temporarily. In this sense, if the level of their foreign reserves is 'too low', then they will rebuild their reserves and sell their currency / buy foreign reserves.
25. Although the primary reason the Bank holds foreign currency reserves is to avoid foreign exchange market dysfunction, there are other reasons for holding reserves beyond that (such as, for example, the RBA approach which is to avoid 'disorderly foreign exchange markets when the exchange rate is perceived as being a long way away from 'fundamentals'). We will brief you on these issues in more detail on the 4th of March. Suffice to say, expanding the objective of intervention policy may entail a higher average level and variability of reserves, more variable costs, and more pros and cons to be considered.
26. **Treasury comments**

The Bank's assessment of the adequacy of foreign reserves provides an opportunity for you and the Governor to discuss the nature of the New Zealand's vulnerability to foreign currency crises, the means available to help reduce the probability of such an event and how to mitigate the impacts should a crisis occur.

Below we consider the role of reserves within New Zealand's broad macroeconomic framework, summarise the key judgements for you to consider in determining how much to invest in reserves, and outline the fiscal impacts of an increase in reserves. We also note that you could make a decision on raising reserves now and that this could be achieved through intervention in the market.

Broad considerations

- Maintaining policy settings that promote broad macroeconomic stability (such as sustainable fiscal policy and low inflation) and sound institutional arrangements (such

as good governance) is the most effective means of avoiding dysfunction in the foreign exchange market.

- History has shown that foreign exchange markets are most vulnerable to collapse where Government's attempt to maintain an exchange rate target (eg a fixed exchange rate) despite the presence of large macroeconomic imbalances or other institutional shortcomings.
- With a floating exchange rate the possibility of similar types of market failure is reduced by the absence of any commitment to any particular rate of exchange. We are not aware of any instances of exchange rate market failure in countries with freely floating exchange rates and sound macroeconomic and institutional settings.
- Nonetheless non-policy factors such as international conditions, threats to biosecurity and changes in the structure of New Zealand's industry could create the possibility of foreign exchange market failure and macroeconomic instability.
- New Zealand's holdings of foreign reserves do not appear to be out of line with similar countries. However, our net external debt position is well above that of most other similar nations. The recent IMF FSAP mission found the New Zealand financial sector to be in good shape overall and well-served to date by our current approach to regulation, although they did raise a number of structural concerns.
- In sum, in considering your decision on reserves it is important to balance the likelihood of a shock hitting and its potential costs against the factors that mitigate against the failure of the exchange rate mechanism such as: the strength of the economy; the soundness of the financial system; the nature of the exchange rate regime; and the strength of the Government's finances.
- The Treasury recognises the useful role reserves could play in helping mitigate the effects of a dysfunctional foreign exchange market. We also note that the economy has grown considerably since the level of reserves was last changed significantly in 1988. We agree with the Bank that the probability of a crisis event in the next few years is low. This provides you with some flexibility in the phasing of an increase in reserves – this includes when to begin and how many years it would take.

Funding options

The Reserve Bank notes that they could increase reserves through intervention in the foreign exchange market rather than by increasing foreign currency borrowing as is usually the case. In our view the issues of reserves for market failure and the broader question about the Bank's intervention policy can best be treated separately. That is the question of how much foreign reserves the Bank should hold for intervention in the case of market disorder should be addressed on its own merits.

The changes to reserves suggested in this paper refer to reserves for market failure only. We think that you could make a decision on this now.

The Bank will be briefing you on the conclusions of its work on foreign exchange rate intervention in March. This discussion could lead you to further reconsider the level of reserves.

Fiscal impacts

- The Bank's proposal to increase reserves by \$NZD1.9 billion over the next four years will lead to an increase in operating costs of around \$1.6 million per year when fully implemented. These costs will be met by the Bank from its earnings on other assets.
- We note the total cost of holding reserves was \$5.5 million in 2002/03. Costs do however vary considerably in line with changes in international market conditions. For example costs in 2001/02 were \$14 million, in 2000/01 a net gain of \$2.7 million was recorded.
- This proposal will have a significant impact on gross debt. Net debt is not affected (the debt issued to finance the proposal is used to purchase assets). Compared to the DEFU projection of gross debt to GDP of around 20.5% in 2007/08 the ratio would be around 21.5%.
- This proposal will also impact on the outcome of work underway to look at lowering the long-term gross debt objective and, revising the short-term objectives to reflect this, as signalled in the BPS.

RBNZ Recommendations

27. It is recommended that you:
- a) **note** that the Bank believes it would be prudent to increase our foreign currency intervention capacity to a SDR 3.0 – 3.3 billion range, from the SDR 1.45 – 1.75 billion range;
 - b) **note** that there is some flexibility around the timing and approach to funding an increase;
 - c) **note** that there are alternative goals to foreign exchange intervention beyond restoring market functionality, and we will brief you on this, and the options around funding, on the 4th of March.

Yours sincerely

Alan Bollard
Governor

Appendix: Background paper on the appropriate level of Foreign Reserves

Introduction and Summary

The Reserve Bank of New Zealand (RBNZ) holds foreign exchange reserves for the purposes of maintaining financial stability in times of dysfunction in the foreign exchange market. The powers for, and purposes of, holding foreign reserves are outlined in Sections 17 and 24 of the Reserve Bank Act 1989. Also in Section 24 is the requirement that Bank from time to time consult with the Minister of Finance as to the level of foreign reserves to be maintained.

The Bank has undertaken an extensive research programme to determine what the appropriate, adequate, level of reserves is. This research programme included literature surveys, cross country studies, building a robust model that has been favourably reviewed by the IMF (as a part of the FSAP process), and discussions with other central banks.⁵

This paper presents the Bank's:

- Reasoning for holding foreign exchange reserves;
- Framework for assessing an appropriate level of foreign reserves;
- Estimate of the appropriate level of reserves, which is above the current level; and,
- Suggestions as to how best to fund any additional reserves.

The Bank has consulted with the Treasury in the drafting of this paper.

Our key findings are:

Disruption in the foreign exchange market can cause considerable economic damage even in an economy that has a floating exchange rate regime and stable macroeconomic policies. The economic damage will be magnified if a short-term currency crisis (or large scale capital outflow) is allowed to manifest into a wider banking crisis.

The Bank sees considerable benefit in certain circumstances from intervening in the foreign exchange market to restore liquidity and reduce extreme exchange rate volatility. By intervening, we imply the Bank being prepared to buy and sell NZ dollars – often when other market-makers have exited.

If intervening, the Bank will have to hold sufficient foreign reserves to at least ensure reasonable NZ Dollar convertibility (or liquidity) under a reasonable range of financial crises. There is no upside to not having spent enough to ensure liquidity, with limited downside to over-compensating for a lack of liquidity.

⁵ This work is available on request.

The cost-benefit analysis of holding foreign reserves (and hence identifying an appropriate level), presented in this paper, balances the certain costs of holding foreign reserves against the uncertain benefits. The costs of holding reserves are largely determined by the level of foreign reserves and the difference between the costs of borrowing and investing. We estimate that the annual cost of holding reserves is about \$750,000 per \$1 billion in reserves.

The uncertain benefits from holding foreign reserves and being prepared to intervene in the foreign exchange market are determined by:

- The probability of a foreign exchange crisis occurring;
- The magnitude of the potential economic loss that could result;
- The effectiveness of foreign exchange intervention in both restoring liquidity and reducing volatility; and
- The risk preference of the policymaker.

The paper presents a formal framework for addressing this issue, providing tractable estimates for the relevant parameters. Attached also are several appendices that elaborate further on some of these issues.

Our analysis suggests that an appropriate level of foreign reserves for NZ may be larger than is currently held. Our current reserve holdings are \$4 billion (or SDR 1.69bn – which is inside our agreed reserves range of SDR 1.4bn to SDR 1.75bn).⁶ On the basis of our research and analysis, the Bank’s recommended appropriate level of reserves is now \$7 billion (or in SDR terms, SDR 2.9 billion).⁷

This recommendation reflects foremost the desire to at least ensure that sufficient reserves are available to restore liquidity in the foreign exchange market. The additional per annum funding cost of these reserves would be in the vicinity of \$2.25 million *per annum* (or around \$5.25 million *per annum* for the full \$7 billion holding).

While the impact of this recommended increase in foreign reserves on net public debt would be minimal, the impact on gross public debt would be more significant and potentially infringe on the Government’s 30% of GDP ceiling.

⁶ In 1998 it was agreed between the Bank and the Minister of Finance that the foreign reserves intervention capacity should be stated in foreign currency terms, and that the appropriate range, measured in the IMF’s Special Drawing Rights (SDR) terms was SDR 1.45bn to SDR 1.75bn. The Bank currently holds SDR 1.69bn of foreign reserves for intervention capacity – which currently equates to around NZ\$4bn.

⁷ We have estimated a range for reserve holdings, which encompasses a reasonable set of assumptions related to the relative costs, benefits, and effectiveness of intervening in the foreign exchange market, as well as the risk preferences of the policymaker, and significantly larger numbers than the \$7 billion can easily be generated.

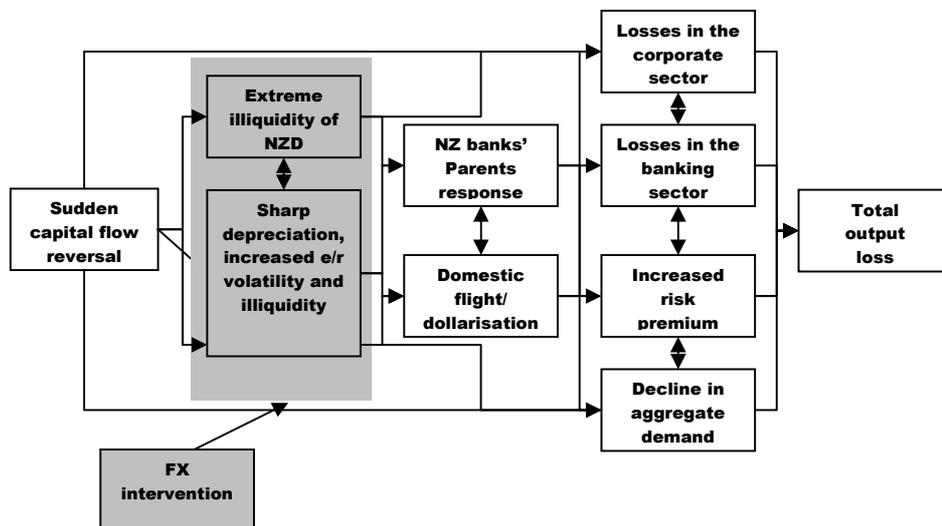
Why we hold reserves

In a situation where some extreme shock or event impacted the New Zealand foreign exchange market to the extent that liquidity was seriously eroded, and a dysfunctional market resulted, foreign exchange reserves would provide an important policy tool. Our reserves facilitate intervention to maintain liquidity (which is important to preserve liquidity, and thereby support trade), and to restrict movements in exchange rates that are due to the dynamics set up by liquidity problems (rather than to a shift in equilibrium exchange rates associated with the originating shock). Indeed, this is the main rationale for holding reserves, although another reason is to support investor perceptions about New Zealand's debt servicing capacity.

However, we need to be comfortable that we hold sufficient reserves to avoid a market breakdown in times of crisis, and thus to limit the subsequent damage to the New Zealand economy.

The damage, or the cost of a crisis, can impact on the economy through a number of channels, as illustrated by Figure 1. A currency crisis is the usual crisis we think about in terms of our intervention policy, that is, the people are actually selling New Zealand dollars to buy foreign currency, to the point where no one is prepared to trade in our domestic currency. The reason for this does not really matter for the sake of our analysis; it can be any large negative shock such as a regional financial contagion, or a natural catastrophe such as a foot-and-mouth disease outbreak, and so on.

Figure 1: Transmission of a currency crisis



The initial negative shock can generate output losses through several channels, some direct, some indirect. A lack of access to foreign capital can result in financial problems, credit rationing, under-investment and bankruptcies in the corporate sector. A decline in corporate profitability can generate further losses in the banking sector. Even for those domestic borrowers still able to access foreign capital, they would do so at a much higher

interest rate because of an increased country risk premium. All these factors would contribute to a decline in aggregate demand and a loss in output.

Together with these direct impacts, the crisis is also likely to influence economic output through the currency market. This would include the following impacts:

- **A sharp depreciation of the exchange rate.** A sudden depreciation may result in output losses through several channels: losses on unhedged foreign exchange positions, changes in the domestic wealth denominated in NZD dollars, and in a further loss of confidence by those foreign investors who previously held NZD-denominated assets. A sharp depreciation can also trigger stop-loss limits at institutional investors and financial institutions, and result in exchange rates overshooting.
- **Increased volatility of the exchange rate.** Increased volatility would result in a higher risk premium on NZD-denominated debt instruments.
- **Extreme illiquidity.** In a crisis, market-makers in the currency market may not be willing or able to maintain highly risky open positions, and could decide to withdraw from the market. A situation can emerge where it becomes very difficult to exchange New Zealand dollar balances for foreign currency ones. Although such a situation is likely to be temporary, even a temporary event is likely to result in long-term losses in output. As a first-round effect, contracts involving FX transactions could not be honoured. Secondly, rebuilding the infrastructure of the foreign exchange market such as the market-maker system would involve significant deadweight costs. The illiquidity can affect investor confidence, resulting in higher international borrowing costs, low credit rating for entities associated with New Zealand, and a loss in confidence in the currency by domestic agents.

If the currency crisis spills over to the banking sector, the cost of the crisis can be much higher – the estimates for countries that have experienced this are in the order of 10 to 20 per cent of annual GDP. These additional costs could arise for a number of reasons, including direct losses by depositors, the loss of confidence in financial intermediation, increasing risk premium, and so on.

Foreign exchange intervention by the Bank can help reduce the output costs of the crisis by preserving confidence and liquidity in the foreign exchange market. This signals commitment by the central bank and increases confidence in the financial system, while supporting a minimum level of trade flows and foreign exchange clearing.

Foreign exchange intervention will impact the propagation of a currency crisis through different channels. Intervention could remedy some of the problems – such as lack of market liquidity, and excessive swings in the exchange rate at the early phase of the crisis. However, even large interventions backed with excessive foreign reserves are unlikely to save the economy from all the costs of a sudden reversal of capital flows. But, appropriate and well-designed interventions are likely to prevent some of the self-propagating crisis mechanisms to develop and foster overall confidence, and thus may save the economy from a significant portion of the crisis costs.

The Target Level of Reserves (Reserve Bank Act Section 24)

If the RBNZ is to hold reserves, then it must hold a sufficient quantity with which to intervene. However, in the absence of a currency crisis we have no recent history of intervention to draw upon, and there exists no generally accepted methodology for determining the level of reserves that we could rely on when assessing the 'optimal' or appropriate amount.

There are no 'right' indicators and not much in the way of a theoretical framework to guide us. Instead, countries typically rely on rules-of-thumb type indicators that provide guidance about broad magnitudes, seen in the context of the individual country's intervention strategy, exchange rate regime, perceptions about the likelihood of experiencing serious liquidity problems in their foreign exchange markets, and risk preferences. The IMF has recently suggested that countries with floating exchange rates should seek to have reserves sufficient to cover short-term debt obligations, although developed countries have rejected this advice as excessively conservative, and indeed unworkable. For illustrative purposes, if New Zealand adopted this rule-of-thumb then we would need to hold around \$ 66 billion in reserves.

The Bank reassesses the level of reserves from time to time, and this paper presents the results of a fundamental review of the level of our reserves. While there have been some minor changes in our reserve holdings by agreement with the Minister of Finance, these have been technical adjustments in nature. We expect that a review of this nature would take place every 5 to 10 years.

In the meantime, the international financial landscape has changed significantly. The size of the New Zealand economy has grown, financial flows have grown bigger, and new and complex financial instruments have been developed. The average daily turnover of global foreign exchange markets, for example, has grown from USD 716 billion in 1989 to USD 1618 billion in 2001. The nature of crises have also changed, shifting away from the traditional current account (fixed exchange rate) type crisis to ones manifested through the capital account. In short while overall risks remain, new types of risks and vulnerabilities have emerged, just as risk management techniques have evolved.

An adequate level of reserves model

The Bank developed a model to provide a framework for assessing an adequate level of reserves. In this model the costs of reserve holdings are assessed against the benefits. The model has a number of parameters that require data or estimates. Some estimates are based on hard data, other on 'softer' data, and still others on assumptions.

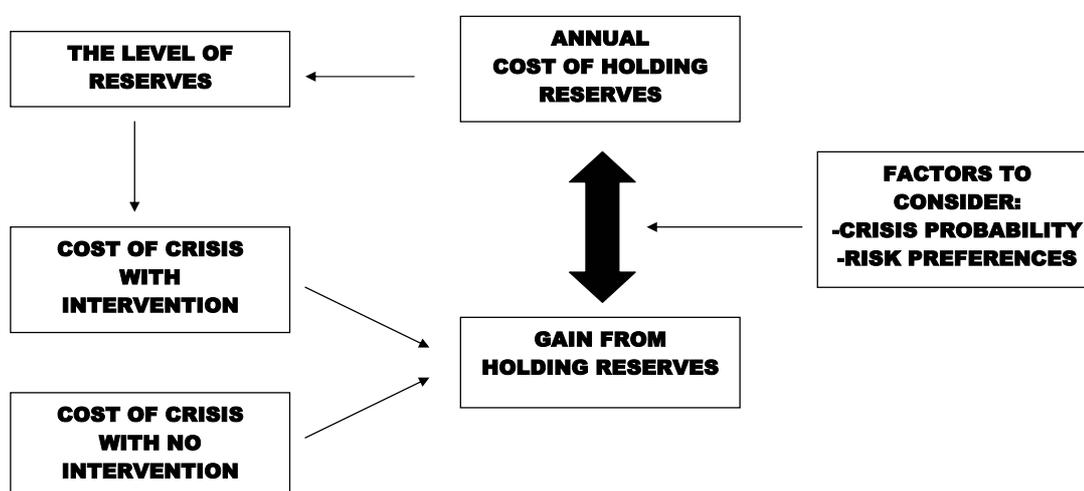
This model, like any model, is just a tool. We provide inputs and the model delivers outputs – outputs that suggest an increase in reserves. Our judgement, even before the development of this model, was that it would be prudent to increase the level of reserves. Neither the model nor the parameters were constructed in such a way to 'prove' this, however, we take some comfort that the results we obtain from the model are consistent

Figure 2 below depicts the main links between the factors taken into account in this cost-benefit analysis.

The main building blocks of the cost-benefit framework are:

1. a relationship between annual reserve holding costs and reserve levels;
2. an estimate for the cost of a crisis with no central bank intervention and a function that describes how this cost diminishes with increasing intervention;
3. assumptions about the probability of a crisis; and
4. assumptions about social (policymaker) risk preferences.

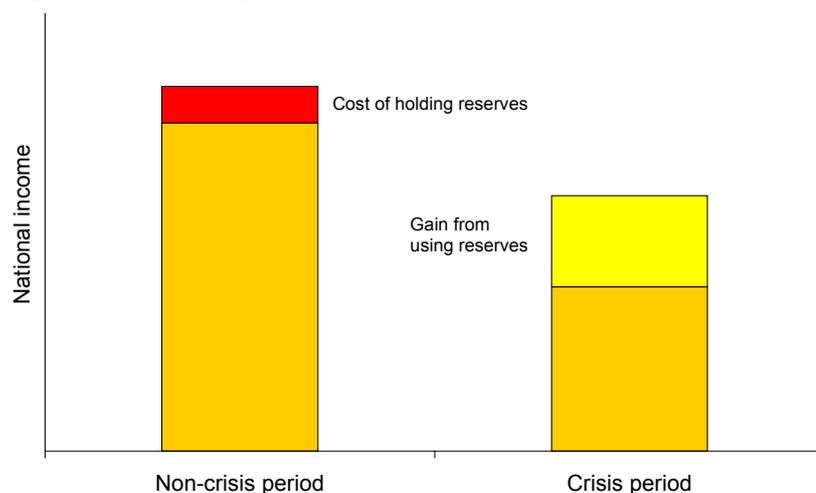
Figure 2: Determining an adequate level of reserves



In a non-crisis year, income is equal to some ‘normal’ level minus the cost of maintaining the level of reserves. This is depicted in the non-crisis year (left) bar in Figure 3, where the total level of national income is reduced somewhat by the cost of holding reserves. In a crisis year (the right-hand bar), the loss arising from the crisis reduces national income – more so if there are no, or insufficient, reserves, and by less so with sufficient reserves and effective intervention. A useful analogy is to think of personal insurance – insurance premiums in non-crisis years reduce disposable income, but having insurance in a crisis year means losses are significantly curtailed.

To choose an adequate level of reserves we have to find a value where the combination of the two (crisis and non-crisis) incomes is the most beneficial for society. The benefits included into the optimisation exercise should not only aim to maximise the expected value of the income, but also takes into account the fact that people are generally risk averse. Hence, we place a higher value on a ‘certain’ income level, even if the mean of this is below the highest expected outcome.

Figure 3: Striking the balance

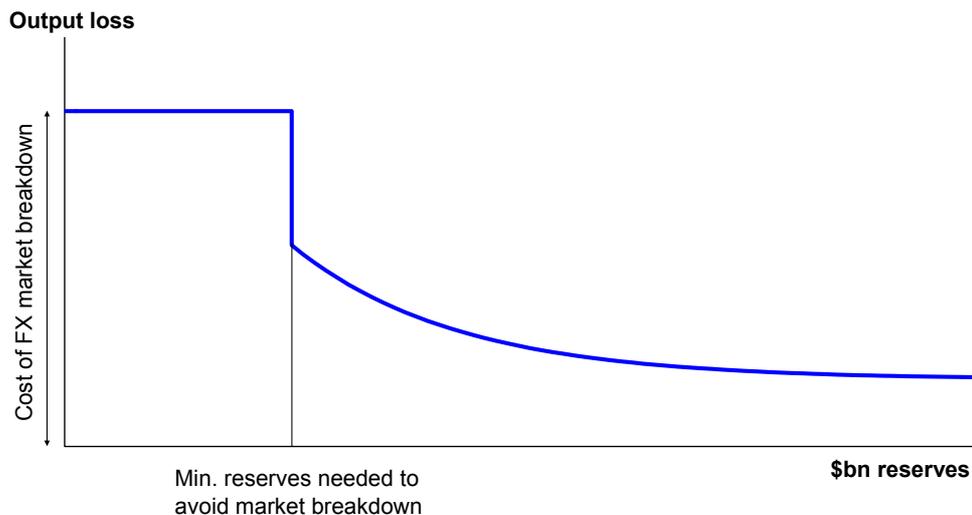


The focus of the model is on having sufficient reserves to restore an illiquid market to an orderly one (or to avoid the market becoming dysfunctional in the first place). A secondary concern is to minimise the costs associated with volatility in the exchange rate. Note we are not talking about defending an exchange rate level.

This is illustrated in Figure 4. Intervention up to a certain level, essentially the amount needed to avoid a market breakdown (R_0 in the model), should be used for providing sufficient liquidity to the market during the crisis to avoid a major disruption. Any intervention less than R_0 is practically useless, as the currency market still remains illiquid, thus the New Zealand dollar becomes temporarily non-convertible, with severe consequences in terms of crisis costs.

If the central bank manages to avoid the market breakdown by intervening by more than R_0 , the cost of the crisis drops significantly. Further intervention may be used for dampening the volatility of the currency market and to reduce or avoid the overshooting of the exchange rate. These interventions gradually decrease further the costs of a crisis. After a certain point the crisis loss function flattens out as the intervention becomes less and less effective. A certain share of the cost remains; it cannot be further reduced by any level of intervention.

Figure 4: The crisis loss function



The optimisation problem for the model, then, is to assess what level of reserves maximises the expected value income, and to take into account society's (the policy-maker's) risk preference.

<p>Easy</p> <p>↓</p> <p>Difficult</p>	<ul style="list-style-type: none"> • Fixed and variable costs of holding reserves • Level of national income
	<ul style="list-style-type: none"> • Probability of crisis • Crisis-related output loss • Degree of risk aversion • Minimum amount of intervention to maintain convertibility
	<ul style="list-style-type: none"> • Parameters that determine the shape of the loss function

The model has a number of parameters, some of which are more readily observable, and therefore easier to calculate, than others:

The parameters in the first box of the table are relatively straightforward to calculate.

- The fixed cost of holding reserves is around \$3 million, although this does fluctuate. This includes staff salaries, equipment and so on.

- The variable cost is approximately \$750,000 per additional \$1 billion of reserves, which is essentially the difference between what we can invest and borrow at. This is based on a risk-adjusted analysis that assumes we invest only in risk-free assets.
- The level of national income was taken to be the current level of the nominal GDP, NZ\$123 billion.

Determining the parameter values for the second group of variables is a little bit more difficult, but they are still able to be obtained through a combination of empirical investigations, conventional assumptions, and some professional judgement. In all of the following variables, our approach was to examine the theoretical and empirical literature, to conduct cross country studies where relevant, and to workshop the results within the Bank.

- The probability of a crisis, for example, is not directly observable, but a conventional assumption is that it is not likely to be a more frequent event than once in 50 years.⁸
- The output losses observed in both developed and developing countries from currency crisis are enormous. The literature estimates currency crisis cost around 8 to 10 per cent of GDP. However, it is also common that a currency crisis will precipitate a banking crisis, and vice versa. This is called a “twin crisis”, and the costs of these are typically in the region of 10 to 20 per cent of GDP. Our view is that the impact of a currency crisis on the New Zealand economy would be less, and is more likely to be in the order of 2 to 8 per cent of GDP, with our central estimate being 4 per cent.
- The risk aversion value is set to 2. A risk neutral value is 0, but research indicates that this underestimates the socially optimal risk aversion, and that it may be as high as 5. We tested across a range of 0 to 5, but settled on the conventional estimate of 2.
- The minimum amount of intervention necessary to maintain convertibility in the foreign exchange market was extensively researched. Several approaches were tried. One focussed on cross country (and historical) empirical analysis on market breakdowns and loss of convertibility from a loss of liquidity perspective. Another looked at the ‘real’ flows (related to actual trade-related transactions, as opposed to ordinary financial market turnover or ‘churn’). Finally, we looked at the actual position limits that traders have and the implications that has for the amount of intervention needed to restore a functioning market. All three approaches were nicely grounded in the real world. Our work suggests that this ranges from \$2 billion to \$8 billion, with our best and central estimate being \$5 billion.

The parameter values in the last box are not observable directly, but relate to our estimates of three issues: the effectiveness of intervention; how much of the cost of the crisis relates to the loss of convertibility; and the proportion of the cost that is unavoidable even with infinite reserves (for example, the fact that the crisis has occurred has reputation effects). We discussed these parameters at length, and tested the across a range of assumptions, but ultimately the values for these parameters were determined through a combination of judgement and our understanding of intervention in markets.

⁸ All of the parameter values are tested around plausible ranges. In the case of the probability of a crisis, for example, we test against the possibility of a one in 100 year event, and a one in 25 year event, although our central estimate is for one in 50 years.

The bottom line

The model has a number of variables, and given the uncertainty around some of these estimates, we have tested a plausible range of values.⁹

Our view that the appropriate level is at the smaller end of the range is based on a number of considerations:

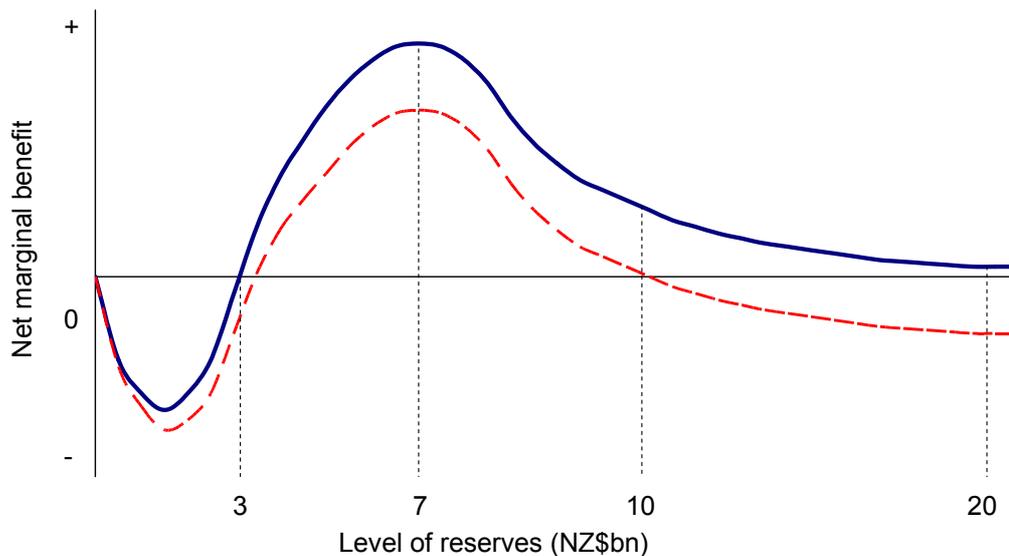
- It is crucial that the RBNZ holds enough reserves to avoid extreme illiquidity in the New Zealand dollar – put another way, R_0 is what matters the most. We consider a plausible range for R_0 to be \$2 billion to \$8 billion, but our central view is that it is in the order of \$5 billion. Setting reserves at \$7 billion means that for all but the worst case scenario, \$7 billion should be sufficient;
- Over and above R_0 , reserves available for restricting volatile movements in exchange rates that are due to the dynamics set up by liquidity problems return positive net present value;
- The combination of relatively cheap net costs of reserves and the relatively long-lived (assumed) positive return on intervention under some assumptions cause the adequate level of reserves become quite large; and,
- There is uncertainty around the effectiveness of intervention to reduce the costs of the crisis, once extreme illiquidity has been avoided.

Figure 5 is a stylised representation of the latter two points. In our view, moving to a higher level of reserves up to a point (that we estimate is \$7 billion) has increasing marginal benefits. Moving to far beyond this point is likely to continue to deliver marginal benefits, but the tail is pretty thin, and, given the uncertainties around the parameters – and especially the success of intervention beyond R_0 – we do not give the same weight to the outer reaches of the range.

This view on the level of reserves number is guided by the framework outlined, as well as research in several relevant areas and professional judgement and experience. The logic of the model reflects our current intervention policy – we do not intervene to defend a level, but to prevent severe market disruptions, and, in times of crisis, to prevent ongoing illiquidity and overshooting in the exchange rate. Also, given the uncertainties around the ranges and loss function, it may be that towards the larger end of the range, the marginal costs may actually outweigh the benefits.

Figure 5: Marginal benefit function

⁹ We do not view the range estimates generated as all equally likely – and therefore prefer our central estimate – but we include the range for illustrative purposes. Working across these plausible ranges generates estimates of the optimal level of reserves between [], but our point estimate is \$7 billion. This is approximately a \$ 3 billion increase to the current level.



[] However, there are other ways to interpret these results:

- Using more reserves than strictly needed to restore liquidity (R_0 in Figure 3) will most likely still have a positive net present value (NPV) as there are costs associated with overshooting exchange rates, especially compared to the costs of not having sufficient reserves. Without sufficient reserves the cost of the crisis would be considerably larger (as credibility is severely affected, defaults occur, and so on).
- Not all of the reserves need to be used if liquidity is restored more easily than expected, which means less 'reloading' would be needed.
- Restoring market order quickly means that there will be some reserves left 'in the tank', and this provides a positive signal to the financial market at the end of an intervention period.
- The cost of additional reserves (in the order of \$2.25 million) is low relative to the potential gain - especially if this addition to reserves is the 'make or break' component in restoring liquidity.

The costs of maintaining reserves

The Bank's foreign reserve holdings are 'pre-funded'. That is, the foreign reserves are held in anticipation of a crisis, with the annual cost of this funding similar to the insurance premium we are prepared to pay to cover the costs of any potential damage.

This pre-funding makes sense for two reasons:

- Almost by definition it would be very costly to raise foreign reserves during a foreign exchange market crisis (if not impossible); and,
- It is easy to assume that the cost of funding reserves will be cheaper prior to a foreign exchange market crisis than in the immediate aftermath – especially if whatever

intervention was done during the crisis proved insufficient to secure convertibility at a reasonable cost.

Are we underestimating the cost of holding reserves by not explicitly accounting for the fact that the Bank will be making a marked-to-market loss in some of its intervention activity while restoring liquidity?

It is not always necessarily the case that the Bank will be making a loss in its foreign exchange market trading. At some point during the intervention, when liquidity is restored in the market and the extent to any overshooting in the exchange rate level becomes evident to market participants, the NZ dollar exchange rate may move favourably for the RBNZ's position. While in marked-to-market terms there may be some significant trading 'losses' recorded during intervention, on a longer-term accruals basis the net financial outcome of intervention is far less certain.

Have we under-represented the costs of intervention by not acknowledging the increased costs of restoring foreign reserves to an appropriate level after a foreign exchange market crisis?

Although the costs of restoring the level of foreign reserves to some appropriate level immediately after a period of intervention may rise, so may the benefits of doing so. Also, we would only restore reserves if we assumed there was still a positive probability of them being needed and carrying a positive NPV. Furthermore, the risks of these increased costs would lead one to argue not to use all of the foreign reserves in any one intervention period – rather to leave some reserves for credibility in the aftermath, thus buying time before full restoration. Hence, one could argue for a higher initial level of reserves.

On balance, for sake of simplicity we have presented the model and intervention strategy as a 'one shot' game.

Funding strategies and the cost of accumulating further reserves

Our recommendation envisages the Bank adding a further 3 billion NZD of reserve assets to the 4.5 billion NZD currently held. This raises a couple of issues:

- Over what time frame should the increase in reserves occur?
- How much will the additional reserves cost to hold?

With regard to the first issue, we note that any increase in reserves, however financed, will result in an increase in consolidated crown gross debt (although effectively no change in net debt levels). Given the government has an upper bound on gross debt issuance, this suggests that a graduated approach should be adopted in building up further reserve assets. One approach would be to build reserves over the next 3 to 5 years as the gross crown debt limit permits, implying an extra \$600-1000 m of gross debt per annum.

The cost to accumulate these extra reserves clearly depends to some extent on the financing opportunities available to the Treasury over the period when reserves are being increased. Note that we assume increased reserves will be financed by foreign currency loans in the same currency as the reserve assets are held. Thus a build up of additional reserves should not in itself imply any impact on local interest rates or the New Zealand dollar exchange rate.

[.....]

However it is not clear that the Treasury could achieve such attractive lending terms in the years ahead – this is an area where advice from NZDMO is required as this is their area of expertise. [.....] Given this margin, combined with our expectation that we would be able to invest in high quality reserve assets at margins between [.....] basis points (depending on the currency and whether commercial paper, near government or government securities are invested in). In practice we would invest in a combination of various types of assets. If we choose to maintain the current mix of government, near-government, and commercial paper investments then each additional \$1 billion of reserves will cost an additional \$750 000 NZD per annum (assuming long run average borrowing margins).

Financial losses associated with intervention

In an intervention situation, existing procedures provide for all intervention to be approved by the Minister either before intervention occurs or shortly thereafter (up to a maximum of \$250 m USD). The financial exposures that arise from intervention are transferred from the Reserve Bank to the Crown balance sheet although in any case, the financial exposures related to intervention accrue to the consolidated Crown balance sheet.

In the long run, intervention is likely to at least breakeven, and in all likelihood be profitable, since the Bank would be purchasing NZD and selling foreign exchange at times when other market participants feel constrained to do likewise. Thus it is likely that the Bank will on average accumulate an intervention position at an exchange rate that is below the long run equilibrium exchange rate (recognising that the new long run equilibrium will likely be lower than the equilibrium that prevailed ahead of the crisis).

However, it is likely that the exchange rate could take quite some time before it returns to equilibrium, implying that the Crown's intervention position could be unprofitable for years after the crisis has past. Hence, the impact on the Crown's budget will likely be one of losses for a few years followed by profits over the medium to long term (e.g. 3-5 years).

Aside from the pattern of losses, intervention implies that the mix of foreign and local currency assets on the crown balance sheet will be disturbed for as long as it takes for the

exchange rate to return to more normal levels and thus for foreign reserves to be re-built. The Crown could choose to rebuild reserves more quickly than this. However this would imply that the Crown might potentially lock in a loss associated with intervention (as it seems likely that at least for a year or two the exchange rate will remain at relatively low levels after a crisis).