

Foreign reserves for crisis management

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This is the first of two articles detailing the Reserve Bank's recent review of its foreign exchange market intervention capabilities. This article deals with the review of the adequacy of foreign reserves that could be used to calm a disorderly foreign exchange market during times of stress. The Bank developed a framework for balancing the costs and benefits of holding reserves, and recommended an increase in the Bank's intervention capacity to around \$7 billion.

1 Introduction and background

Since the New Zealand dollar was floated 20 years ago, the Reserve Bank has limited its policy on foreign exchange market intervention to periods of 'extreme market disorder', when the operation of the market itself is under threat. New Zealand's flexible exchange rate regime means that periods of extreme disorder are likely to be very rare, and to date the Bank has not found it necessary to intervene for this purpose.

However, the Reserve Bank of New Zealand Act 1989 (the Act) does allow the Bank to operate in the foreign exchange market under a wider range of conditions. First, the Bank can deal in the market on its own terms, with the expectation that this power will be used to support the Bank's everyday functions, such as monetary policy implementation. Second, the Minister of Finance can direct the Bank to intervene, within set guidelines, for the purpose of influencing the exchange rate. This is intended to be more of an emergency power than a routine one. Under this section of the Act, the Minister has given the Bank a standing order to intervene at any time to ensure the continuous operation of the foreign exchange market.

The Act also establishes the Bank's obligation to hold foreign reserves in order to carry out intervention at short notice. The Minister is required to review the appropriate level of reserves "from time to time", although the target range for the value of reserves has been broadly unchanged at around

\$4–5 billion since 1988.² The level of reserves has not kept pace with the size of New Zealand's economy or the foreign exchange market, and has lagged the recent growth in reserves held by other central banks.

In 2003 the Bank conducted a two-part review of its intervention capacity. The first part, reviewed in this article, was a formal review of the level of reserves held for crisis management purposes. The other part – a reappraisal of the role of intervention beyond crisis management purposes – is detailed in Kelly Eckhold and Chris Hunt's article in this issue of the *Bulletin*.

This article proceeds as follows: Section 2 looks at the reasons for intervening in the foreign exchange market and for holding foreign reserves. Section 3 reviews recent thinking on the appropriate level of reserves, and compares New Zealand's reserves with international benchmarks. Section 4 explains the framework that the Bank developed to assess the costs and benefits of holding reserves. Section 5 details the Bank's recommendation to the Minister on the appropriate level of reserves.

2 The role of intervention and foreign reserves

The role of foreign exchange intervention depends on a country's exchange rate regime. Some currencies operate as managed floats, where there is a central role for intervention to support exchange rate policy. For a free-floating currency such as the New Zealand dollar, the role of intervention is

¹ This article expands on the background paper provided to the Minister of Finance on 9 February 2004, which is available at www.rbnz.govt.nz/finmarkets/foreignreserves/intervention/0144001.html. The recommendation was the product of a substantial body of work by many people within the Bank, in particular Wai Kin Choy, Aron Gereben, Danica Irvine, Daniel Wills and Ian Woolford.

² In 1998 it was agreed to specify the target in IMF Special Drawing Rights (SDRs), which are based on a basket of international currencies. In a crisis situation the Bank would sell foreign currencies to buy New Zealand dollars, so it is the level of foreign currency holdings that matters. For this article, all values are in New Zealand dollars.

less clear-cut. But there are two general situations where a central bank may still need to intervene.

The first is to calm the foreign exchange market when it becomes disorderly. Disorderly behaviour is largely in the eye of the beholder – central banks tend to refer to behaviour such as excessive short-run volatility, trends driven by momentum trading rather than fundamentals, or a perceived overshoot of ‘fair value’ at the top or bottom of the exchange rate cycle. In this case, the goal of intervention is to influence the level or direction of the exchange rate. The central bank could be buying or selling the domestic currency, and can also transact in the forward market, so it does not necessarily need to hold foreign reserves in advance.

The second situation is avoiding market dysfunction, or a complete breakdown in the market for the domestic currency. Recent work on the microstructure of foreign exchange markets suggests that even a free-floating currency can be vulnerable to a market breakdown.³ Foreign exchange markets resemble a complex network: small shocks can be absorbed, but larger shocks may be transmitted or even amplified, and parts of the network could cease to function under pressure. In this case, the main priority of intervention is to keep the foreign exchange market functioning, and to maintain the market’s confidence in the currency as the exchange rate adjusts to a new equilibrium.

The New Zealand dollar market has some features that make it more vulnerable than most to a breakdown. The market is relatively small, there are only a few committed price-makers (dealers that quote buy and sell prices throughout the day), and there is an unusually high reliance on capital inflows from overseas, which investors could attempt to withdraw at short notice in a crisis.

The expected costs of a market breakdown go beyond the losses from exchange rate exposures. Banks and other firms may have difficulty finding counterparties that are willing to provide hedging for future exposures. Offshore investors would almost certainly require a larger premium for lending in New Zealand dollars, which would mean substantially higher

interest rates and lower credit ratings. Appropriate and well-designed intervention could prevent the development of self-propagating crisis mechanisms, and would significantly reduce the costs to the wider economy.

Imagining a dysfunctional market

Since there is no history of foreign exchange market breakdowns for free-floating currencies, it is difficult to anticipate what it may look like when one occurs, or to determine when it would be necessary for the Bank to intervene. Nevertheless, it is unlikely that a crisis would unfold so quickly that the Bank would have no warning of a market breakdown. The following section is an attempt to capture the most likely sequence of events in a dysfunctional market.

A market breakdown would need a trigger, such as a major economic shock – an example that the Bank has used before in its research is an outbreak of foot-and-mouth disease in New Zealand.⁴ The initial reaction would be a sharp fall in the exchange rate, since a negative economic shock would require a lower equilibrium exchange rate. The exchange rate would also be quite volatile as traders struggled to ‘find’ the new equilibrium level.

The adjustment process could become disorderly if traders suffered losses and attempted to exit their positions at the same time. The response by speculators is uncertain – arguably they would serve a useful role in moving the exchange rate towards its new equilibrium; but if the market were in danger of breaking down, it may be more sensible for speculators to get out of the market altogether. This would actually reduce the market’s liquidity and increase the risk of a breakdown.

At first, price-makers may respond by increasing the spread between their quoted buy and sell prices, and reducing their exposure to exchange rate risk. But they may decide that no spread is large enough to compensate them for the risks of dealing in a volatile and unpredictable market, and would stop quoting prices. If one price-maker pulled out of the

³ Some of the relevant features of the market are noted in Archer, D and J Halliday (1998), “The rationale for holding foreign currency reserves”, *Bulletin* 61(4), 346–54.

⁴ For example, see “Stress testing the New Zealand banking system”, *Financial Stability Report*, Reserve Bank of New Zealand, October 2004.

small New Zealand dollar market, there would be pressure on the remaining price-makers to do the same.

Eventually, price-making would cease altogether, and the market would be considered dysfunctional. While the market may not be completely paralysed, trades would only occur if buyers and sellers could be matched up directly. There would be substantial short-term costs arising from delays in settling trades, extremely wide spreads, and volatile exchange rates. The Bank would need to intervene before this point, in order to maintain confidence in the New Zealand dollar market. It would be difficult to persuade price-makers and investors to re-enter the market once it has already broken down.

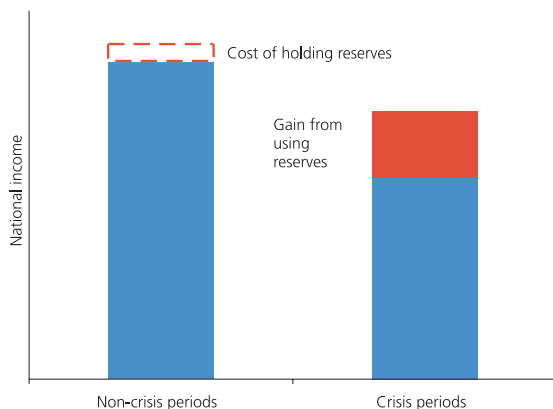
Foreign reserves as insurance

In a way, foreign reserves are a form of insurance. If a country sets aside some of its income during normal times, it will have some protection to draw on for those rare occasions when a crisis occurs. The Bank would probably not be able to acquire foreign currencies in the middle of a crisis, just as a homeowner would not be able to buy insurance for their house while it is burning down.

The appropriate amount of insurance depends on the trade-off between the price of the premium and the payout following a trigger event. The 'premium' in this case is the ongoing costs of holding and managing foreign reserves, and the 'payout' is the fall in national income that can be avoided by using reserves in a crisis, as shown in figure 1.

Arguably, if there is a role for insurance, then participants in the foreign exchange market should insure themselves

Figure 1
Balancing the costs and benefits of reserves



against the possibility of losses. But the major costs of a dysfunctional market would arise from the breakdown of the network, rather than losses from individual exposures. Similarly, individuals can easily insure against personal losses from an earthquake, but not against damage to infrastructure such as electricity and water supplies. This suggests that there is a role for a central institution, such as the Reserve Bank, to provide a socially optimal level of insurance.

3 How much is enough?

Many countries have increased their foreign reserves, at least in absolute terms, in the last five years. In particular, some of those countries that experienced large capital outflows during the Asian crisis in 1997–98 have increased their reserves several times over. Given the economic and social costs of that event, those countries may justifiably feel that more is better when it comes to reserves.

But the costs of holding too many reserves, while less apparent, can also be substantial. Foreign reserves are not a panacea for financial crises, particularly when the underlying cause is an imbalance in the domestic economy. Many Asian countries held large amounts of reserves even before the Asian crisis, which may have created a false sense of security about their ability to deal with financial crises.

Another issue is that once a central bank enters the foreign exchange market, it may find it difficult to exit. If intervention becomes a regular activity, market participants may come to rely on the central bank to take on exchange rate risk on their behalf. As a consequence, the optimal level of reserves is probably not open-ended, but lies within a certain range.

An international comparison of the level of foreign reserves is a useful starting point. International investors and credit rating agencies seem to regard the size of a country's reserves as an indicator of its financial soundness, regardless of whether they contribute to a country's debt servicing capability. These parties would probably express concern if New Zealand's reserves were substantially out of line with the rest of the world.

Table 1
Comparison of reserves

Reserves to:	Value	Ranking
GDP	6.0%	20/31
Imports	2.7 months	20/36
M2 money supply	6.9%	29/33
Foreign short-term debt	27.3%	20/21
Daily foreign exchange turnover	3.1 days	21/32

The Bank compared New Zealand's reserves with a peer group of 35 countries, which included all of the OECD countries and some of the more developed emerging market countries with access to international capital markets. The level of reserves was divided by a range of measures, to adjust for the size of the real economy or the level of activity in the foreign exchange market.

Table 1 shows a selection of ratios and New Zealand's rankings. Countries were ranked from highest to lowest; so for example, New Zealand's ratio of reserves to M2 was the fifth-lowest. The number of comparator countries for each ratio depends on data availability, and the measurement of reserves, money supply, short-term debt and turnover can differ across countries. Therefore, the broad picture is more important than the individual rankings. New Zealand tends to sit at the lower end of the range, but is not an outlier by any of these measures.

There have been a few attempts to relate these types of ratios to the adequacy of reserves. An old rule-of-thumb states that reserves should cover at least three months' worth of imports. This rule originated at a time when terms-of-trade shocks were the major cause of currency crises. Today, capital flows are much larger and potentially more volatile than trade flows, so the import coverage rule has become less relevant for a country with open capital markets such as New Zealand.

A more recent rule-of-thumb suggests that countries should manage their external position so that they could live without overseas borrowing for one year. In practice, this means that foreign reserves should cover at least 100 per cent of foreign short-term debt (maturing in less than one year). This rule is considered more appropriate for developing economies, where financial crises tend to be longer-lived. Even so, recent

work by the IMF suggests that this rule, with some extra conditions, is an appropriate guide to the level of reserves.

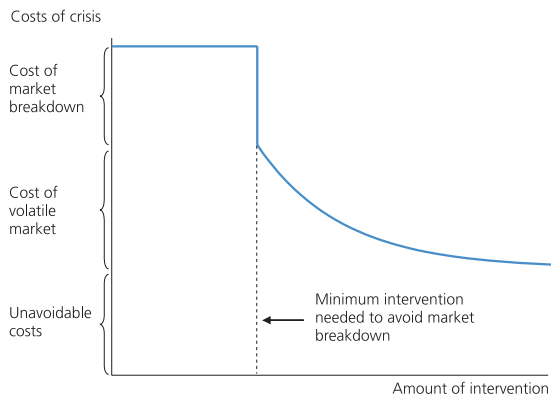
International comparisons and rules-of-thumb suggest that New Zealand's reserves are lower than many of its peers, but are not abnormally low. However, neither approach deals with the crucial issue of whether reserves are adequate for a country's specific circumstances. This problem led the Bank to develop a generic framework for assessing the costs and benefits of holding reserves.

4 A framework for the optimal level of reserves

Rather than generating the 'right' number for the level of reserves, the framework was designed to bring together a combination of theoretical literature, empirical research, conventional assumptions, and professional judgement. The framework reflects many of the ideas discussed in this article so far. Reserves are treated as a type of insurance that can be exercised in the rare event of a currency market breakdown. In normal times, the country pays a premium to hold and manage its reserves. When a crisis occurs, much of the value of intervention comes from keeping the foreign exchange market functioning.

Figure 2 is a stylised version of the relationship between the amount of intervention and the economic cost of a dysfunctional market. Without intervention, the foreign exchange market would break down in a crisis, imposing a substantial cost on the economy. If there is too little intervention to prevent a market breakdown, the cost to the economy would be the same as if there is no intervention at all. But if the Bank intervened enough to avoid a market breakdown, there would be a substantial one-off reduction in the total cost of the crisis.

Figure 2
Stylised function of the costs of a currency crisis



Even if the market continues to function, it could still be disorderly and volatile. Any further intervention beyond this point could be used to calm the market and reduce the damage to the economy, although it would become less effective as intervention increased, and some of the economic costs would be unavoidable. The curved section in figure 2 reflects the effectiveness of intervention in reducing market volatility. But the value of further intervention has to be weighed against the costs of holding additional reserves during normal times.

The framework requires values for several parameters, some of which are more difficult to estimate than others. Table 2 lists the main parameters, roughly in order of difficulty, and notes the central estimates where appropriate. Given the high degree of uncertainty around some of these variables,

the Bank also conducted sensitivity tests with a plausible range of values for each parameter. The rest of this section elaborates on the estimation of the major parameters.

Costs of holding reserves

The first two parameters are the annual costs of holding reserves.⁵ The fixed costs of managing reserves include staff salaries, computers, and access to information services. Fixed costs were assumed to be \$3 million per year on average, although the results were not very sensitive to this parameter. The variable cost is the margin between the cost of borrowing in foreign currencies and the returns from investing in low-risk assets. The recommendation was based on the estimated variable cost at the time of the review, which was 7.5 basis points or \$750,000 per \$1 billion of reserves.

Recently, the Crown has been able to borrow at substantially lower rates by raising New Zealand dollars and swapping them into foreign currencies. As a result, the margin is actually positive for the Crown – as large as 40 basis points – and as matured loans are rolled over, holding reserves should become profitable in time. The margin may not always be so favourable, but the Crown will continue to fund reserves in this way as long as it is economical. This reinforces the point that the cost of holding reserves is small relative to the expected benefits from intervening in a crisis period.

Table 2
Parameters of the framework

Parameter:	Value:
Fixed costs of holding reserves	\$3m per year
Variable costs of holding reserves	0.075% of reserves
Probability of a crisis	2% per year
Crisis-related output loss	4% of GDP
Minimum intervention needed to avoid market breakdown	\$5bn
Risk aversion	Standard assumption
Costs of volatile market	>10% of total cost
Unavoidable costs	20% of total cost
Effectiveness of additional intervention	Varies

⁵ For more detail, see Hayward, T, P McKenzie and W Potter (2002), “Managing New Zealand’s foreign reserves”, *Bulletin* 65(4).

Probability of a crisis

The probability of a financial crisis in any given year was set at 2 per cent. For most individual countries, major financial crises have been fortunately rare, but this makes it difficult to say anything about their regularity. One stylised fact is that many developed countries experienced financial distress in the 1890s, the early 1930s and the late 1980s – roughly once every 50 years.

Ultimately, though, financial crises are not probabilistic events. They are due to specific developments, such as the severe economic depression in the 1930s, or the burst of speculative activity following widespread deregulation in the 1980s. Once in 50 years is a reasonable approximation, but it was necessary to test for other possibilities. In the sensitivity analysis, the probability of a crisis ranged from 1 to 4 per cent per year.

Crisis-related output loss

The economic cost of a dysfunctional foreign exchange market would depend on the nature and severity of the event. The most relevant literature looks at the historical costs of currency crises, defined as a sharp fall in the exchange rate at a time when a country's wider financial system is under strain.⁶

There are two issues in estimating the costs of currency crises. The first is that currency crises often coincide with banking sector crises, which in turn may arise in a recession. Few studies have attempted to isolate the costs that are directly related to the strain in the foreign exchange market. The second issue is the assumed 'counterfactual', that is, how quickly the economy would have grown if the crisis had not occurred.

The average estimated cost of a currency crisis is around 6 to 12 per cent of GDP, but with substantial variation across countries – in some cases the cost was 20 per cent of GDP or more, while in a few cases the impact on growth was virtually zero. The cost tends to be lower in developed countries than in developing countries, although the small

number of crisis events among developed countries makes it difficult to draw strong conclusions.

Financial crises are either caused or magnified by factors such as fixed or pegged exchange rates, poorly-executed deregulation of the financial sector, poor monetary and fiscal policies, or corruption. None of these factors are expected to be an issue for New Zealand in the foreseeable future. Therefore, it is more likely that the cost of a crisis in New Zealand would be at the lower end of historical estimates. The Bank settled on a central estimate of 4 per cent of GDP, and tested for values between 2 and 8 per cent.

Minimum intervention needed to avoid market breakdown

The amount of intervention required to avoid a market breakdown is probably the most important variable in the framework. To avoid a breakdown, the Bank would need to ensure that key transactions could be completed even when the market is under stress. A single foreign exchange transaction can generate several 'pass-the-parcel' trades, as dealers pass on the associated risk and rebalance their inventories.⁷ This means that the volume of core trades – those trades that need to occur on a given day – is probably much lower than total foreign exchange turnover.

The three approaches that the Bank used to estimate the value of core transactions are described in box 1. Within each approach the Bank tested a range of assumptions, to create a distribution of estimates. The distribution suggested that \$5 billion of intervention capacity would be enough to prevent market breakdown in most circumstances.

Risk aversion

The risk aversion parameter reflects society's preference for certain over uncertain outcomes. Higher risk aversion would suggest a greater degree of income smoothing between crisis and non-crisis periods, which would mean a higher optimal level of reserves. The Bank used a conventional assumption

⁶ A comprehensive review can be found in Hoggarth, G, R Reis and V Saporta (2001), "Costs of banking system instability: some empirical evidence," Bank of England Working Paper 144.

⁷ This is one of the microstructure aspects of the foreign exchange market that could lead to a market breakdown under stress.

Box 1

Three approaches to measuring core transactions

Liquidity-based: the market requires a minimum level of liquidity to remain functional. Liquidity can be measured in several ways; the Bank used measures such as total trading volume and volume relative to price volatility. The minimum level of liquidity was varied, with the upper limit being the lowest level of liquidity observed in the past (because the New Zealand dollar market has never broken before). On average, currency crises in other countries have seen a 40 per cent fall in liquidity, lasting for about six days. This provided an estimate of the shortfall in liquidity that the Bank would need to provide, in order to return the market to at least the minimum level of liquidity.

Balance of payments-based: using balance of payments data, the Bank attempted to separate core flows – those transactions that would have to occur on a given day, such as import payments and debt repayments – from

discretionary flows such as speculative investments and ‘pass-the-parcel’ trades. Core flows were estimated to be about 25 per cent of total foreign exchange market turnover. Assuming a six-day crisis period, and some changes in hedging behaviour, the Bank estimated the total core transactions that would need to be funded during a crisis.

Limit-based: price-makers in the foreign exchange market build up positions in various currencies as orders arrive throughout the day. The price-makers set limits on how much exchange rate risk they are willing to bear for each currency, and as they approach these limits they will look to reduce their exposure. By surveying the price-makers in the New Zealand dollar market, the Bank estimated the amount of New Zealand dollar sales that price-makers would be willing to absorb in a crisis. Once they reached their limits, the Bank could intervene to clear their New Zealand dollar positions, allowing them to continue dealing.

of 2 (risk-averse), but also tested for values between 0 (risk-neutral) and 5 (extremely risk-averse).

Additional intervention

The final three parameters in the framework deal with the effectiveness of additional intervention, beyond what is needed to avoid a market breakdown. These parameters are not directly observable, and they were determined through a combination of judgement and understanding of intervention in financial markets. The Bank tested a range of assumptions for this part of the framework.

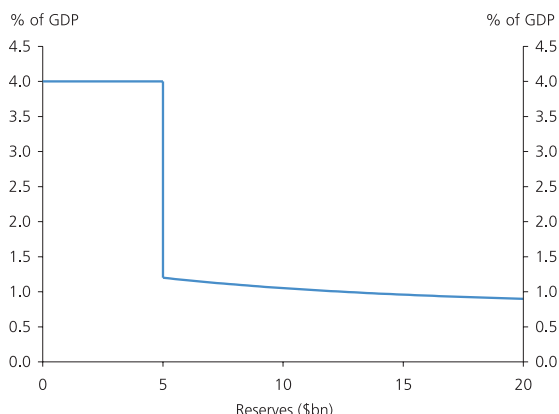
Because the New Zealand dollar market is relatively small, and there are few offshore parties that need to take on exchange rate risk, most offshore investment in New Zealand is discretionary. This means that the market has to maintain a good reputation in order to continue to attract investment. It was felt that most of the crisis costs would result from the loss of reputation following a breakdown of the market.

The unavoidable costs of a crisis were believed to be relatively low, and were set at 20 per cent of the total cost. It is important to note that the ‘total cost’ refers strictly to the costs of foreign exchange market dysfunction. In practice, a currency crisis may coincide with a wider banking sector crisis or a severe economic slowdown. The unavoidable costs would be quite high in this instance, because reserves would be of no use in dealing with the crisis.

Given the Bank’s intended approach to intervention, the benefits of reducing volatility would be relatively small. The Bank would not target a particular level of the exchange rate, but would continue to supply liquidity by acting as a price-maker. However, this is a role that the Bank would be aiming to hand over to private sector price-makers as soon as practical. As a result, it is not clear that further intervention would add much value.

The Bank’s overall view on the effectiveness of extra intervention is reflected in the shape of the loss function in figure 3. Sensitivity analysis showed that in almost

Figure 3
Loss function



every situation, there would be some benefit to having an intervention capacity beyond the required minimum, but not by a great margin.

5 Recommendation

The Bank recommended that its intervention capacity for crisis management should be increased to a minimum of \$7 billion.⁸ The recommendation was accepted by the Minister of Finance in February 2004.

The recommended level was at the lower end of the range of estimates produced within the framework, although it should be recognised that the framework was just one input in the process. The most crucial factor – the minimum intervention needed to avoid market breakdown – was estimated at

\$5 billion, with a chance that it could be as high as \$7 billion. With a minimum of \$7 billion in reserves, the Bank could avoid a market breakdown in most circumstances, and in many cases would have the capacity to dampen market volatility if necessary.

In the recommendation, the Bank noted that the total amount of foreign currencies that could be made available in a crisis situation extended beyond the Bank's existing foreign reserves of \$3.7 billion. The Treasury holds liquid foreign currency assets of around \$500 million, and New Zealand has a reserve tranche position with the International Monetary Fund (IMF) of about \$900 million, giving a total of \$5.1 billion that could be accessed at short notice. Therefore, the Bank requested an additional \$1.9 billion of reserves in order to reach the new target.

The additional reserves will be provided over four years. Given the Crown's current approach to funding, the increase in reserves will not create any *net* New Zealand dollar flows, so it will not have a direct impact on the exchange rate.

It is likely that the Bank will review the level of reserves again some time in the next few years. The optimal reserves framework will help to make this more transparent and straightforward, although re-estimating all of the parameters will not be a simple task. The framework is general enough that it could also be used to assess the level of reserves under different intervention policies, so other central banks may find it useful as well.

⁸ More accurately, the Bank recommended an increase in the target range from SDR 1.45–1.75 billion to a minimum of SDR 3.0–3.3 billion. The conversion rate at the time of the review was NZD 1 = SDR 0.45.