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Editor's Note

In recent issues of the *Reserve Bank of New Zealand Bulletin*, we have published articles covering a range of the Reserve Bank's functions, including ones that tend to lie in the shadows of the Bank's more prominent roles. In this issue of the *Bulletin* we continue that practice by including an article on an important, but generally not well known, role of the Bank – the management of foreign exchange reserves. We also continue our recent series of articles on the theme of macro-prudential stability issues, with a piece on the balance of payments. But our first article deals with the Bank's core function of monetary policy, focusing on a central element in monetary policy – the Bank's economic forecasts and the accuracy of those forecasts.

An important part of the Bank's approach to monetary policy is forecasting economic conditions and assessing likely inflationary pressures. In order to enhance the transparency of the Bank's forecasts, and to assist market participants understand the Bank's thinking in relation to monetary policy, the Bank has long been in the practice of publishing its forecasts as part of its quarterly *Monetary Policy Statements*. In doing so, we are obviously mindful of the need to make our forecasts as accurate as possible. However, despite all the best intentions and thorough preparation, no forecasts will ever be completely accurate. That is the nature of forecasting – when looking into the future, the only certainty is that there is no certainty.

Like other forecasters, the Bank makes strenuous efforts to make its forecasting processes as robust as possible and to continuously improve our forecasting ability. Part of this process involves periodically reviewing the accuracy of our forecasts and comparing their performance with that of other economic forecasters.

We have recently concluded a review of our forecasting performance. The first article in this issue of the *Bulletin* summarises the results of that review. The article focuses particularly on the Bank's CPI inflation forecasting performance, but also examines our forecasts of other key macroeconomic variables, given their relevance for explaining our CPI forecasts.

The article notes that the accuracy of the Bank's inflation forecasts is similar to that of most other forecasters over the period under review (ie most of the 1990s), but that we

tended to have a bias towards under-predicting the inflation rate. We conclude that, in the mid-1990s, underestimation of growth, and overestimation of the economy's capacity to grow without generating inflation pressures, were the source of most of our under-prediction of medium-term CPI inflation. From 1998 until recently, the major factor appears to be sizeable and persistent differences between the assumptions we used for the path of the exchange rate and its actual evolution. We also conclude that contributions to forecast inaccuracies have at times been made by our understanding of the non-inflationary output growth rate, the equilibrium exchange rate and exchange rate pass-through into CPI inflation. However, these factors do not appear to be systematic sources of inflation forecast bias.

Overall, the article concludes that our CPI forecasting bias has not compromised the Bank's ability to conduct sound monetary policy and that CPI inflation outcomes over the period reviewed are fully consistent with the Bank's obligations under the Policy Targets Agreement.

The second article deals with the Bank's approach to the management of foreign exchange reserves. New Zealand holds foreign reserves primarily to enable the Reserve Bank to intervene in the New Zealand currency market if serious liquidity problems were to develop. Holding reserves involves balancing a number of factors. We need to have assets that we can readily convert into cash in a crisis. But holding reserves costs money. We want to minimise that cost wherever possible, but do so without exposing the Bank to excessive financial risks. Much of this article is about how we balance these considerations and about the risk management framework applicable to our foreign reserves operations. It also discusses our active management approach to foreign reserves, undertaken with the objectives of reducing the risk-adjusted cost of holding reserves and enhancing our understanding of financial markets.

In the third article, we continue the series on external and macro-financial stability issues. This article looks at the balance of payments data for New Zealand, particularly in relation to capital transactions, and tries to deepen our understanding of the way balance of payments data are compiled and the difficulties inherent in interpreting trends in the balance of payments. The article provides several

examples of how corporate financing choices could affect measured flows in the balance of payments capital and current accounts. An important conclusion of the article is the need for caution when interpreting balance of payments data, particularly in assessing a country's macro-financial stability.

This issue of the *Bulletin* also contains a copy of the speech given recently by the Governor of the Bank, Dr Alan Bollard – his first on-the-record speech since his appointment as Governor. It provides a useful insight into Dr Bollard's interpretation of the new Policy Targets Agreement and how he sees this influencing the Bank's approach to monetary policy.

I hope readers enjoy the material in this issue of the *Bulletin*. On behalf of my colleagues at the Reserve Bank, I wish our readers a joyful Christmas and a rewarding year ahead.

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The Reserve Bank's forecasting performance

Sharon McCaw and Satish Ranchhod, Economics Department

For most of the period since 1994, the target range for annual Consumers Price Index (CPI) inflation, established by the Policy Targets Agreements (PTA), was 0 to 3 per cent. Over this period, actual CPI inflation has averaged 2 per cent. As one might expect, analysis shows that our medium-term CPI inflation forecasts since 1994 have been biased towards under-prediction, which is the subject of this article.

In any particular period, inflation is unlikely to be exactly as forecast, given that the economy is affected by unforeseeable events and inflation is far from perfectly controllable. However, it is important to have a good understanding of why inflation has evolved as it has, and not as predicted. We need to know whether particular events in the period under consideration have dominated inflation outcomes, or whether there is a fundamental problem with the policy process – such as a fundamental misunderstanding of the workings of the economy – that would systematically affect future monetary policy outcomes unless corrected.

In this article we focus particularly on our CPI inflation forecasting performance, but also examine our forecasts of other key macroeconomic variables, given their relevance for explaining our CPI forecasts.

We conclude that, in the mid-1990s, underestimation of growth, and overestimation of the economy's capacity to grow without generating inflation pressures, were the source of most of our under-prediction of medium-term CPI inflation. From 1998 until recently, the major factor explaining the under-prediction of inflation appears to have been sizeable and persistent differences between the assumptions we used for the path of the exchange rate and its actual evolution.

We also conclude that contributions to forecast inaccuracies have at times been made by our understanding of the non-inflationary output growth rate, the equilibrium exchange rate and exchange rate pass-through into CPI inflation. However, these factors do not appear to be systematic sources of inflation forecast bias.

1 Introduction

Most macroeconomic forecasters periodically examine their forecast performance in order to check their understanding of the workings of the economy and improve their forecasting capacity. Central banks, in particular, continually review their projection methodology and performance within the context of its relevance for the effective operation of monetary policy. This article discusses the Reserve Bank's forecast performance over the past decade, with a particular focus on Consumers Price Index (CPI) inflation.

Optimal monetary policy is forward-looking, taking account of time lags before policy actions affect the economy. For this reason, most inflation-targeting central banks use projections to guide policy. We do likewise, but we are relatively unusual among central banks in two respects: we

publish relatively complete economic projections that are tied quite closely to the current monetary policy decision,¹ and we allow for monetary policy to evolve in the future depicted within those projections.

The primary reason we publish such projections is their value as a communication tool. Our projections provide a sense of where we currently believe the economy is headed, but just as importantly, also provide a framework for communicating our understanding of relationships within the economy. The implications of emerging information can then be assessed by both the Bank and financial markets against a well-articulated benchmark, thereby reducing uncertainty about our likely actions.

¹ **The central banks of Britain and Sweden both regularly publish forecasts of inflation up to two years ahead. The Bank of Canada and the Reserve Bank of Australia publish less detailed information regarding projected inflation.**

However, projections are not the “be all and end all” of monetary policy, and are highly conditional on the information available at the time the forecasts are prepared. They are almost invariably ‘wrong’ in some sense, due to the complexity and ever-changing nature of the economy, and a constant procession of unforeseeable events, such as large oil price movements, world trade policy changes, and droughts. Indeed, most variation in the economy comes from factors we cannot predict. In addition, economic data are often available only with a significant delay, and can be volatile and/or subject to measurement error and revision. Consequently, making projections as prominent as we do in communicating the rationale for policy actions carries with it the risk of observers imputing a spurious importance to the exact numbers contained in them, with attendant damage to our credibility.

Nonetheless, even though a set of economic projections cannot capture everything relevant to determining appropriate policy settings, it does reflect a central view of what we think is happening to the economy and how these forces will develop over time. It is important that we have a good grasp of how well we understand these factors.

An analysis of our historical forecast errors is one means of assessing our understanding of the economy and the operation of monetary policy over time. The inability to foresee the future means that we expect our projections to be wrong, but in a random way. If we are making non-random errors, it is important to understand why this has occurred and any implications for future projections and the operation of monetary policy. In this article we present the results of our most recent analysis of our forecast errors, with an emphasis on CPI inflation. We turn first to a brief description of key measures of forecast performance.

2 Assessing forecast performance

Allowing for the likelihood that economic outturns will be different from those projected, there are two basic yardsticks that can be used to measure forecast performance:

- A basic performance measure is how accurate the forecast is, in terms of the average size of its error. This can be measured by the mean absolute error or the root mean squared error.²
- Second, we can test whether or not forecasts are biased – ie whether they tend to consistently under- or over-predict.

We used these basic yardsticks in a recent review of our forecast performance, with particular emphasis on the issue of bias. Previous research has focused more on the accuracy of our projections, defined in terms of the average size of the error or squared error of the forecasts for particular variables. It has also tended to focus on our near-term forecast performance. The issue of bias, particularly at the longer horizons, which are generally most relevant for forward-looking monetary policy, has received less attention. Because economic cycles typically take several years to complete, and many cycles are required in order to get a range of different types of events, examination of bias requires very long samples to generate reliable results. It remains a moot point as to whether the sample period for this evaluation exercise is sufficiently long to give reliable results.

We also compared our projections for selected variables with those of some other forecasters. Comparing projections between one forecaster and another is problematic, as forecasts may be prepared at different times, with one forecaster having more recent data than another. In addition, the projections may have been produced for quite different purposes. However, with caveats, forecasting comparison can be a useful exercise.

² For descriptions of these statistics see appendix 1.

3 The conditionality of Reserve Bank projections

Before assessing the properties of the Bank's published forecasts, it is useful to examine some of the issues around this process.

Prior to 1997, we framed our forecasts in terms of the question "What will happen to inflation if we don't change interest rates?" In addition, the real exchange rate was assumed to remain constant at its then current level – not reflecting that we thought this was the most likely outcome, but for consistency with the unchanged interest rate assumption. This approach was clearly not, and was not intended to be, a realistic representation of policy.³ The projections were regarded as a useful tool for demonstrating the motivation behind the monetary policy decision, but they were not unconditional forecasts of the perceived most likely paths for each variable.

In the Forecasting and Policy System (FPS) model used at the Reserve Bank since mid-1997, a conditional monetary policy response is built into the model.⁴ By construction, the projected interest rate path is one, but not the only one, that will result in an inflation projection consistent with the Policy Targets Agreement, given anticipated economic developments. In addition, the exchange rate is assumed gradually to trend back to a long-run equilibrium level, influenced along the way by the evolving interest rate path. In effect, these projections ask, "What do we have to do to keep inflation consistent with the Policy Targets Agreement?"

This monetary policy response is conditional on all other variables evolving exactly as projected, which is of course not considered particularly likely. New, unanticipated events inevitably arise. Moreover, like most economic forecasters, we project smoothly-evolving paths for economic variables, whereas in the real world economic developments tend to

occur with greater volatility. For these reasons, we constantly stress the conditionality of the projections to discourage readers from misinterpreting our forecasts as a strongly-held view on future economic developments.

The forecast errors over the periods before and after mid-1997 must therefore be interpreted differently. Examining the forecasting performance of one variable in isolation in either period - and particularly across both - using traditional measures of forecast accuracy must be undertaken with this caveat in mind.⁵

We now turn to a brief description of our inflation forecasting performance.

4 Our inflation forecast performance

Over our sample period beginning in December 1994, we have on average significantly underestimated inflation in the CPI excluding interest rates, beyond the very near term. We have under-predicted annual inflation one year ahead by nearly 0.7 percentage points on average, and two years ahead by nearly 0.9 percentage points.⁶ As one would expect, the size of our forecast errors increases as the

³ For this reason, if inflation was projected to go outside the target band, then we would occasionally assume a step adjustment in rates.

⁴ For further information about the FPS model, see Reserve Bank of New Zealand (1997) and Hampton (2002).

⁵ A further caveat to interpretation of our forecast errors is that they are also conditional on accepting others' views, such as The Treasury's forecasts of the fiscal position and *Consensus Economics* (or earlier, Organisation for Economic Co-operation and Development) forecasts of world growth.

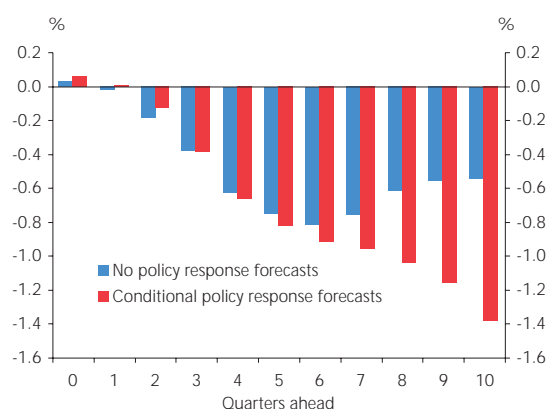
⁶ These data are adjusted for the large fall in Housing New Zealand rentals in 2001. We also examined quarterly inflation forecasts. Findings were entirely consistent; the bias in our quarterly inflation forecasts is at least 0.2 percentage points per quarter at these horizons.

projection horizon lengthens, reflecting the greater uncertainty inherent in looking further into the future. Key statistics are given in table 1 in appendix 2.

Note that there is a key period where we considerably overestimated inflation (1991-92). This period is not included in our analysis, both because of difficulties obtaining the background data, and because the disinflationary period of the early 1990s is conceptually different from the stable inflation period. If this period were to be included, there may be less evidence of bias in our average CPI forecast errors.

As discussed in section 3, in 1997 we changed the way in which our forecasts were generated. Prior to this, our projections incorporated largely flat-line technical assumptions for interest rates and real exchange rates. Subsequently, our projections have contained a conditional policy response, where the Reserve Bank is assumed to respond to projected inflation pressures in order to return inflation to an appropriate level. For short- to medium-term forecast horizons, our inflation forecasts were similar in terms of bias and accuracy under the two forecasting regimes, while at longer forecast horizons (8 to 10 quarters ahead) our inflation forecasts have in fact been less accurate since the adoption of conditional policy response forecasts (see figure 1).

Figure 1
Mean forecast errors for annual CPI inflation



However, simply ascribing the different forecasting performance to the methodologies used in the two regimes is misleading, as the accuracy of our forecasts is strongly influenced by particular economic events during each period, including the “Asian crisis plus drought” event and the exchange rate cycle.

Comparison with other forecasters

We compared our annual CPI inflation forecasts since June 1992 with those of eight other forecasters.⁷ Our CPI inflation forecasts have not been significantly more or less biased or accurate than those of most other forecasters.⁸ However, two forecasters have produced medium-term inflation forecasts that are considerably less biased than ours. Key statistics comparing our inflation forecasts with these two are presented in table 3 in appendix 2.⁹ We therefore examined their macroeconomic forecasts in greater detail and discuss the results throughout this paper.

International comparison

Because most central banks do not publish forecasts, there is not a great deal of information available regarding their forecasting performance. However, some key findings for foreign central banks and other public sector forecasters are given below.

- The Australian government’s official forecasts have tended to under-predict year-ahead annual inflation by about 0.4 percentage points between 1978 and 1988, and over-predict by about the same amount from 1989 to 1999 (Richardson 2000).
- The International Monetary Fund April/May forecasts of following-year inflation for the G7 countries between 1990-96 tended to be too high (by about 0.3 percentage points), but less so than those of Consensus Economics (about 0.5 percentage points) (Batchelor 2001).
- The Federal Reserve Open Market Committee in the United States tended to over-predict year-ahead annual

⁷ The exact sample for each forecaster is dependent on available data.

⁸ This conclusion contrasts slightly with previous research (see Reserve Bank of New Zealand 2001a), which had a smaller sample period and a slightly different methodology.

⁹ A caveat to these results is that most of one forecaster’s projections between May 1998 and September 2000 were published several weeks after the Bank finalised its projections. This includes the Asian crisis, a period during which the economic outlook was changing rapidly. However, even excluding this period, their inflation forecasts are less biased than our own.

inflation by around 0.4 percentage points on average during 1979 to 2001 (Gavin and Mandel 2002).

- In relation to the Bank of England's inflation forecasts, produced with an assumption of constant nominal interest rates, they have this to say: "During 1993 and most of 1994, the Bank's central forecasts were clearly too pessimistic about the path of future inflation. The forecasts made in November 1994 and February 1995 were, by contrast, too optimistic. Forecasts made from May to November 1995 were broadly on track. Quantifying these forecasting errors to date suggests a mean (absolute) error in the region of 1% one year ahead." (Haldane 1997).

This is by no means an exhaustive set of findings, but it illustrates that the Reserve Bank of New Zealand is not unusual in having experienced biased inflation forecasts from time to time.¹⁰

We now consider some of the possible causes of our CPI inflation forecast bias.

5 Possible causes of biased inflation projections

The process of creating our economic projections and finally reaching an Official Cash Rate (OCR) decision is outlined in figure 2.¹¹ Many different factors contribute to our final projections, and there are therefore several points at which bias could enter the process.

- Biased technical assumptions. Prior to 1997, the key technical assumptions were the interest rate and real exchange rate tracks, both of which were mostly held constant at the levels prevailing at the time the forecasts were prepared. Since mid-1997, both variables have been allowed to evolve through the projection, but the exchange rate's evolution still reflects a technical

assumption rather than a forecast. Any mechanical projection methodology, including the use of technical assumptions, can lead to biased estimates over a specific sample period.

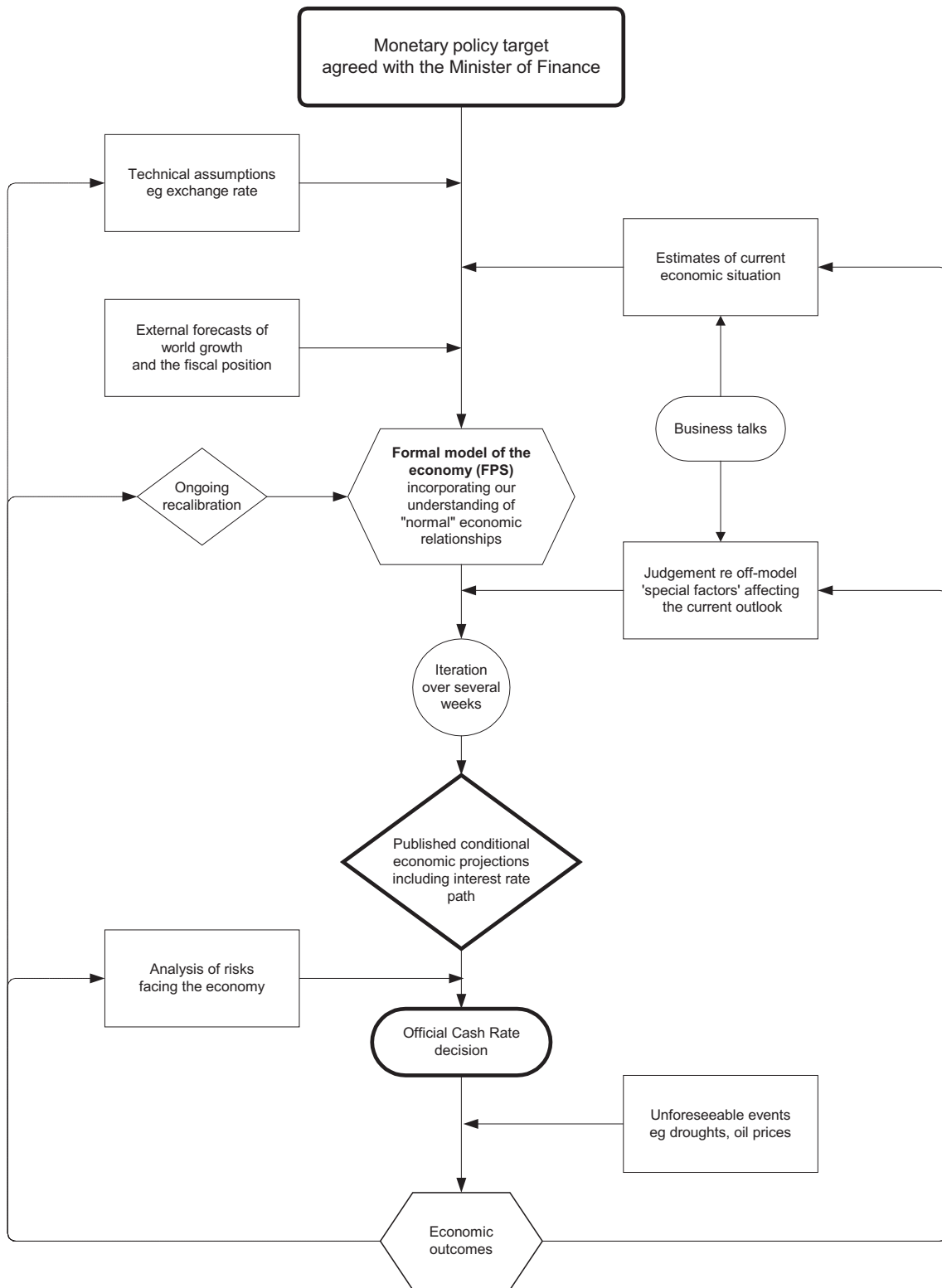
- Biased fiscal and world growth forecasts. These forecasts are not made by the Reserve Bank, but are taken from other forecasters.¹² If these forecasts are biased, it could contribute to bias in the Bank's forecasts.
- Biased changes in data. Some data series, such as real Gross Domestic Product (GDP), are prone to revision, particularly in respect of the most recent data. If the latest data we receive are biased first estimates, this could cause biased forecasts.
- Biased understanding of economic relationships. If we make errors, such as overestimating how fast the economy can grow without causing inflation, miscalculating the impact of interest rates on activity, or misjudging the impact of the exchange rate on inflation, biased forecasts could result. It is therefore necessary to continually reassess the view of economic relationships as new information comes to hand.
- Biased judgement of 'special factors'. The FPS model is a useful tool for ensuring that the projections add up, both in an accounting and stock-flow consistency sense. However, FPS cannot capture all the complexities inherent in evaluating the current and future economic situation. Judgement is always applied to the FPS model in order to shape its output to reflect the special factors affecting the current outlook, and other non-model information, such as findings from our regular visits to businesses. If the judgement being applied is biased, this could also lead to biased inflation forecasts.
- Biased risk perception. We cannot build a full profile of perceived risks into our economic projections, but they are built into monetary policy decisions. If we were to have a biased perception of risks, this could lead to biased inflation outcomes. One way of measuring this is by assessing any bias between projected interest rates and actual interest rate decisions.

¹⁰ Most of these analyses include the disinflation period of the early 1990s, when around the world, as in New Zealand, inflation was brought under control more quickly than generally anticipated.

¹¹ For more information about the Reserve Bank forecasting process, see Drew *et al* (1998).

¹² Fiscal forecasts are sourced from The Treasury. Forecasts of growth in our trading partners are sourced from Consensus Economics Inc. which survey a range of economic forecasters on a monthly basis and report average forecasts.

Figure 2
The monetary policy process



- Biased unforeseeable events. It is also possible that the pattern of unforeseeable events occurring over the forecast period could have a tendency to influence inflation predominantly in one direction or another, particularly over a limited sample period. Normally, forecasters rely on the pattern of unforeseeable future events being unbiased, particularly over longer time periods.

We now turn to the results of our investigations into the source of our inflation forecast bias. We examine each of the theoretically possible causes outlined above.

i) *Technical assumptions*

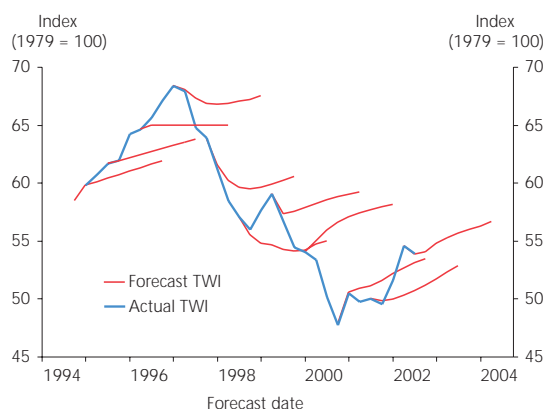
The exchange rate is extremely difficult to forecast. We therefore make ‘technical assumptions’ about future values, with no claim that the given path is necessarily more likely than any other.

As discussed, prior to 1997, we used an assumption that the real exchange rate would stay constant at its then current level. By contrast, in the FPS model used since June 1997, the exchange rates (defined in terms of the Trade Weighted Index – TWI) is largely assumed to return to a long-run equilibrium level (although with some influence en route from interest rate differentials relative to other countries). The assumed long-run equilibrium can be adjusted over time. This essentially mechanical methodology should produce unbiased ‘forecasts’ over a number of full exchange rate cycles, to the extent that the assumption about the long-run equilibrium is correct. However, it may lead to errors being in the same direction for prolonged periods, depending on the nature of exchange rate cycles over the relevant periods, as shown in figure 3.

It can be seen that the exchange rate forecasts do not appear to be returning to the same equilibrium. We have revised down our estimate of the equilibrium long-run exchange rate since 1997-98. This earlier over-estimation contributed to our exchange rate over-prediction at that time.

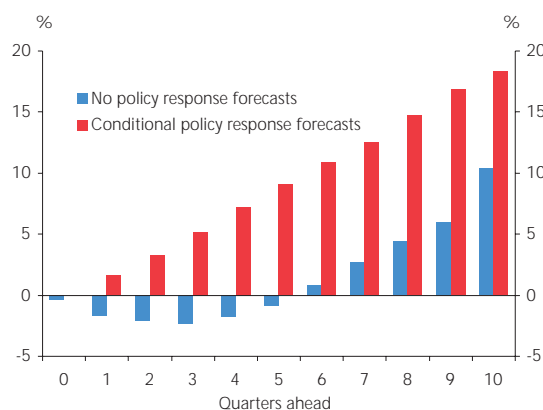
We tended to over-predict the exchange rate when it was falling (as did other forecasters). Overall, we have a bias towards over-prediction in the sample period December 1994 to September 2002. The bias has been much more pronounced post-1997, which was the peak of the TWI cycle.

Figure 3
TWI levels and Reserve Bank assumptions
(3 quarter intervals)



On average since March 1997, our one year-ahead forecasts have tended to be 7 per cent higher than the actual TWI, and two years out our forecasts have been 15 per cent higher (figure 4). There is some indication at the end of the period depicted in figure 3 that, as the exchange rate has started to rise, over-prediction has given way to under-prediction, as would be expected.

Figure 4
TWI mean projection errors (expressed in percentage level deviations)



How much is the exchange rate bias likely to have contributed to our CPI inflation forecasting bias? An exchange rate fall makes the domestic currency price of imported goods rise, which causes CPI inflation to increase (depending on the level of exchange rate pass-through, among other factors). There is also a slower, second-round effect on inflation as the increase in exporters’ incomes feeds into demand. If we

conservatively assume a TWI pass-through of 0.2, with half occurring in the first year, a 7 per cent movement in the TWI level would, all else being equal, lead to the CPI level being around 0.7 percentage points higher a year later. This would be enough to explain the observed CPI bias of 0.7 percentage points in the period since March 1997.¹³

We then compared our exchange rate forecasts with the two forecasters who had less biased CPI forecasts than we did. While one of the two forecasters may have had slightly better TWI forecasts, the other over-predicted it by a greater amount than we did over the sample period. Thus, exchange rate level forecasts alone cannot explain the difference in our inflation forecasting performance.¹⁴

ii) Fiscal and world growth forecasts

Any bias in externally-sourced forecast variables will affect the accuracy of our inflation projections to some degree. However, there was little evidence of bias in the fiscal forecasts we obtain from The Treasury. In addition, fiscal policy has been relatively stable since the Fiscal Responsibility Act 1994 was enacted, reducing the impact of fiscal impulses on the overall outlook.

It is also possible that biased world growth forecasts may have been a factor. Prior to 1998, we used Organisation for Economic Co-operation and Development (OECD) forecasts of industrial production. Since then, we have used Consensus Economics Inc forecasts of growth in our main trading partners. Only occasionally have we departed from these forecasts, each time reducing them. For example, during the Asian crisis and drought events over 1997/98, and also following recent equity market falls, we made slight adjustments out of concern that the externally-sourced forecasts did not fully reflect the then current overseas economic developments. The question of whether these forecasts are biased is difficult to examine because of the very short sample periods; more data are required to assess this.

iii) Estimation of demand pressure

When an economy is growing strongly, there tends to be more upward pressure on prices. However, GDP growth is not always the best measure of the 'heat' in the economy. Not all changes in GDP growth reflect changes in demand, and hence changes in potential inflation pressure. The capacity of the economy to meet that demand without causing inflation can also change, in response to such factors as large oil price movements, productivity developments and technological change. Failing to recognise this could lead to monetary policy errors, such as tightening policy in response to high economic growth even though it transpired that that pace of growth would not have generated unusual inflation pressure. At the other extreme, acting to stimulate demand when the economy's capacity to grow has in fact unexpectedly slowed could risk a severe inflation problem.

The output gap is one way of allowing for the fact that the supply side of the economy is just as important as demand, and is also subject to change. It is defined as the difference between the level of total economic output (GDP) and 'potential' output (which in this conception is the level of growth consistent with stable inflation). For details on how we calculate potential output and hence the output gap, see box 1.

Our analysis has revealed that, on average, we have underestimated the amount of inflation pressures in the economy related to the balance between demand and supply. That is, our estimates of the output gap at the start of our forecasts have been significantly biased towards underestimation since 1997 (when we started formally using the concept in our forecasts). Figure 6 shows our output gap starting-point errors through time. Our average mean error was quite significant at times during the late 1990s. We also consider that we underestimated demand-led inflation pressure in the mid-1990s. However, as we were not formally calculating and forecasting the output gap at this time, this period is not included in this numerical analysis.

¹³ We also tried putting the exchange rate bias into the FPS model as a shock, but results were very sensitive to assumptions regarding agents' learning, and other technical assumptions.

¹⁴ In addition, our forecasting performance with respect to world import prices was not significantly different to these two forecasters.

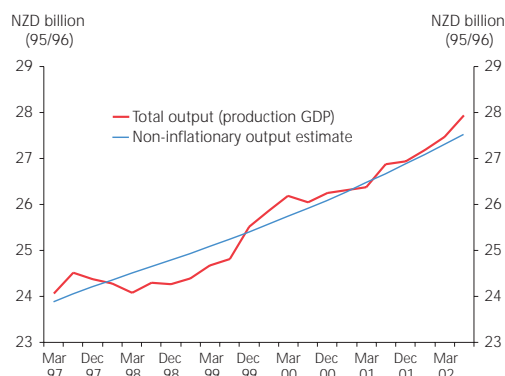
Box 1: Estimating the output gap

The output gap is defined as the difference between the current level of output in the economy and the estimated level thought to be consistent with not generating any inflationary or disinflationary pressures (often referred to, somewhat misleadingly, as “potential output” or, less misleadingly, as “trend output”). Inevitably, estimating trend output is a problematic task and there is always a significant degree of uncertainty surrounding it. Despite our best efforts to estimate trend output with as much accuracy as possible, there is no perfect science in its estimation.

We use a flexible (non-linear) trend to estimate the unobservable level of trend output by smoothing through total GDP using both past and future observations. This methodology automatically allows for gradual changes in trend output growth over time, while more transitory movements in total output are generally assumed to reflect cycles in aggregate demand.

At the end of the sample, the filter lacks future data to guide it. The filter therefore also makes some use of other indicators of resource strain (eg capacity utilisation) to guide our output gap estimates. The final component

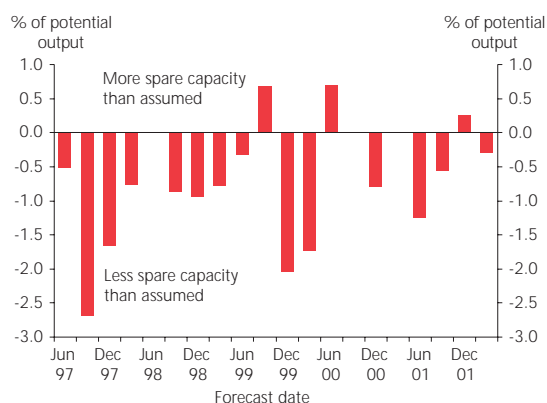
Figure 5
Actual output and estimated non-inflationary output



is a “stiffener”, an adjustable factor which allows a constant assumed long-run growth rate of trend output to influence our estimates over the last few years of data.

Despite these extra sources of information, the end point of the historical output gap estimation (ie the start point of the forecasts) will always be prone to quite substantial revision from quarter to quarter.¹⁶

Figure 6
Starting-point output gap estimation errors¹⁵



How important is the output gap bias in explaining our inflation forecast bias? As a very rough rule of thumb, we put this period-average output gap bias profile into the FPS

model as a ‘shock’ simulation, not allowing monetary policy to respond for several quarters to emulate the ‘forecast error’ aspect. We found that, under reasonable assumptions about how quickly we learned about the error, the average output gap bias could explain about half of the average CPI forecast bias. (Note that the effect would have been bigger earlier in the period, when the output gap errors were larger).

There are several potential causes for underestimating demand-led inflation - underestimating total growth (either in our forecasts of, or Statistics New Zealand revisions to, GDP), or overestimating the sustainable speed at which the economy can grow. We examine each in turn.

¹⁵ Note that the ‘actual’ data here are the estimates from the September 2002 forecasts, as the ‘true’ output gap is unobservable.

¹⁶ For more information on the Reserve Bank’s usage of the output gap concept see Claus *et al* (2000).

GDP forecasts

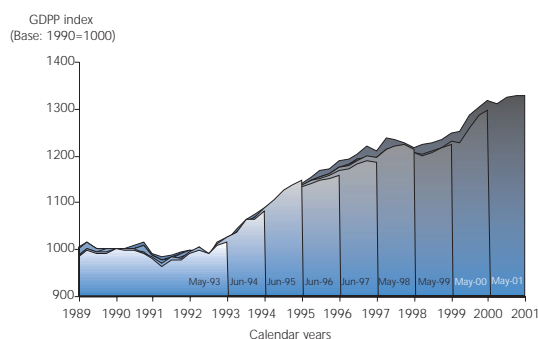
It appears that our near-term forecasts of GDP growth are unbiased, while in the medium-term we have tended to overestimate GDP growth, if anything.¹⁷ It therefore does not appear that we have exhibited a general tendency to underestimate growth. That is not to say that we have not underestimated growth at times, and that this could have contributed to our inflation forecast errors for that period. We concluded in our 1999 business cycle review¹⁸ that underestimating demand pressures in 1995-96 was one factor contributing to our under-prediction of inflation in the mid-1990s.

GDP revisions

Research has shown that the largest influence on changes to our view of the medium-term outlook for the economy is changes to our view about the current economic situation.¹⁹ An accurate assessment of the economy's starting point is therefore very important. Data revisions to key series such as GDP can have a sizeable impact on our projections, influencing our interpretation of inflation pressures in the economy.

Revisions to historical GDP data since 1993 (figure 7) have tended to be one-sided. The average revision has tended to raise annual growth in expenditure GDP by 0.7 percentage points, and production GDP (which we focus on) by 0.3

Figure 7
Real production GDP revisions



¹⁷ This bias in our quarterly growth estimates is approximately 0.2 to 0.3 percentage points 4 to 8 quarters ahead, though this is imprecisely estimated.

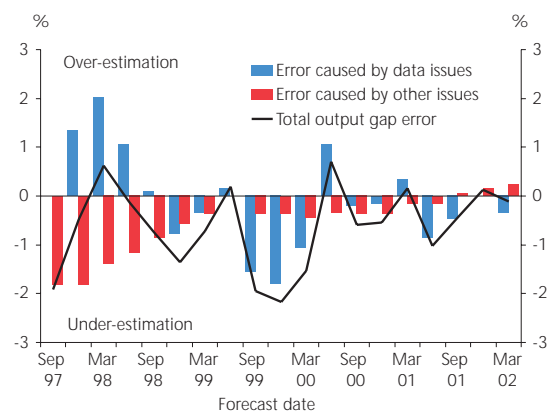
¹⁸ Drew and Orr (1999).

¹⁹ Reserve Bank of New Zealand (2001b)

percentage points. All else being equal, an underestimation of growth would lead to an underestimation of inflation pressures.

However, not all of this extra growth necessarily reflects growth on the demand side. Some of it may also be growth in the supply side of the economy, particularly through increased investment. This is captured automatically in our output gap framework: some of these revisions go into our estimates of non-inflationary growth, rather than all acting to increase our estimates of demand-led inflation pressures (see box 1). In figure 8, 'data issues' (the blue bars) reflect our estimate of the impact of GDP revisions on our starting-point output gap estimates. It appears that while revisions have led to quite substantial changes to our estimate of the output gap starting point, these have not been one-sided, and hence the contribution to the CPI inflation forecast bias has been both towards under- and over-prediction at times.

Figure 8
Contributors to the output gap starting-point bias



Therefore, while GDP revisions have added unhelpful noise to our output gap starting-point estimates (and hence, on occasions, worsened the accuracy of our inflation forecasts), we conclude that they have not added bias.²⁰

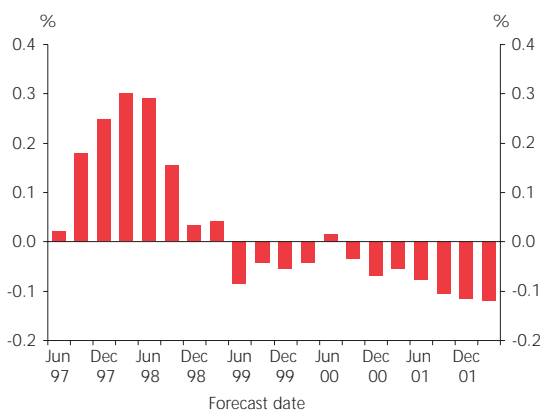
Taking out the effect of data revisions, the remaining output gap errors are largely one-sided (the red bars in figure 8). We have ruled out our near-term GDP forecasts as the source

²⁰ Statistics New Zealand are constantly improving their measurement methods and expect GDP revisions to be smaller in future.

of this bias, as they appear unbiased. This leaves over-optimism regarding the 'speed limit' at which the economy can grow without generating inflation pressures. Box 1 described how we estimate this growth rate. Although we begin with a mechanical filtering process, we then judgementally adjust this estimate.

Examination of revisions to our historical estimates and forecasts of trend output growth confirms that we have had a tendency to overestimate growth in the productive capacity of the economy. This has contributed to underestimation of inflationary pressures, and hence the CPI. Figure 9 gives our errors estimating the current quarter's growth in the economy's supply capacity, ie trend output.²¹ We now consider that we over-predicted this in 1997-98 by up to 0.3 per cent per quarter, or over 1 per cent per year. As discussed above, some of the errors are due to data revisions. However, during 1997-98, data revisions were impacting on our output gap estimates in the opposite direction (see figure 8).²²

Figure 9
Starting-point trend output quarterly growth forecast errors



It therefore seems likely that overestimation of the economy's ability to grow without generating inflation pressure during 1997-98 was a driver of our inflation forecast bias during this period. These years were influenced by the Asian crisis

plus drought period: from September 1997 to March 1998 we considerably over-predicted near-term GDP growth.²³ All else being equal, this would lead to an over-prediction of inflation during this period. However, all else was not equal, because of our overestimation of the growth in the economy's ability to meet demand growth over the period.

Prior to 1997, our evaluation of the balance between demand and supply in the economy was made outside the output gap framework. We therefore cannot examine our estimates and forecasts of the economy's capacity to meet demand for this period quantitatively. However, we concluded in our 1999 business cycle review that "it appears that in the early to mid-1990s the Bank underestimated the strength of the demand pressures, and overestimated the increase in the supply capacity of the economy. The net result was the emergence of stronger inflation pressures than anticipated".²⁴

There is little evidence that our estimates of the economy's capacity to grow without generating inflation pressures have been a driver of inflation forecast errors in either direction since 1999.

iv) *Our understanding of economic relationships*

Modelling the economy is inherently difficult. Economic relationships are continually evolving. A period of rapid and large-scale structural reform, such as New Zealand underwent over the decade from 1984, makes for considerable uncertainty about how the economy will respond to monetary policy and other events, as history is no longer a good guide. We continually modify our economic model to reflect structural or behavioural changes in the economy. However, no model can perfectly capture these kinds of developments. Over time, we have gradually obtained more post-reform data, and our view of some key economic relationships has evolved accordingly.

In the previous section, we noted that over the 1990s we tended to overestimate the 'speed limit' of the economy. In

²¹ The 'correct' data are the September 2002 estimates for the series, given that trend output is unobservable.

²² Note that we are examining quarterly growth in trend output, while the output gap is a levels concept. Therefore there is no simple quarter-to-quarter correspondence between the two.

²³ This was then followed by a slight underestimation of how quickly the economy would recover in early 1999.

²⁴ Drew and Orr (1999).

addition to this, we have gradually revised our view on exchange rate pass-through into CPI inflation. We believe that the pass-through has actually fallen over the past decade.²⁵ Now that we have the benefit of a full exchange rate cycle during the stable-inflation period, we also believe that we may have previously overestimated the pass-through. Importers' margins appear to be more flexible than previously thought. This could be a further contributor to the CPI forecast bias, as we overestimated not only the level of the exchange rate on average over the period, but possibly also the disinflationary impact of the projected appreciation.

Another potential explanation for our CPI forecast bias is that we might have overestimated the power of interest rates to brake the economy (ie underestimated the neutral real interest rate – the interest rate that is neither stimulatory nor contractionary on the economy). However, if this were the case, then we would expect to see GDP growth higher than projected, all else being equal.²⁶ While we certainly have underestimated GDP growth on occasion (eg 1994-95), over the sample period, quarterly GDP growth has been slightly lower than we projected, on average.

We also compared our GDP forecasts with those of other forecasters, to shed light on this question. Our growth forecasts have not been significantly more or less biased than other forecasters at any of the forecast horizons considered. Also, the two forecasters who had considerably higher (and hence less biased) medium-term CPI inflation forecasts than us had roughly similar nominal interest rate tracks, and hence considerably lower *real* interest rate forecasts. Hence, there is no evidence that our estimate of the power of interest rates is a large driver of the difference between our CPI inflation bias and others'.

v) *Judgement on special factors*

A macroeconomic model is by necessity extremely simplified. It is therefore important that forecasts can be manually adjusted to reflect the complex and ever-changing realities of the economy. The Bank's Monetary Policy Committee's views on the structure of the economy, behavioural relationships and the current economic situation that are not already built into the FPS model are captured in judgements incorporated into the final forecasts. For example, we may have heard on business visits that firms are responding to the exchange rate somewhat differently to the traditional way because of strong views of its likely future path. Or we may have gleaned insights into the likely future paths for our commodity prices that lie outside the parameters built into the model.

Since we began using the FPS model, we have been able to archive early iterations of our forecasts. Generally, judgement included between the first 'sensible' run and the final published forecasts has tended to reduce the output gap forecasts and the interest rate track. This judgement has been appropriate in that it has made our interest rate projections more accurate, but it has worsened the output gap bias slightly (despite improving our growth forecasts). This would seem to suggest that judgement has worsened our inflation forecast bias. However, the judgements during 1997-98 dominate findings. During this period we were still learning about and recalibrating FPS. Since that time, the FPS model has become more consistent with the policy makers' and staff's views on how the economy works, meaning that less application of out-of-model judgement has been required.

vi) *Perception of economic risks*

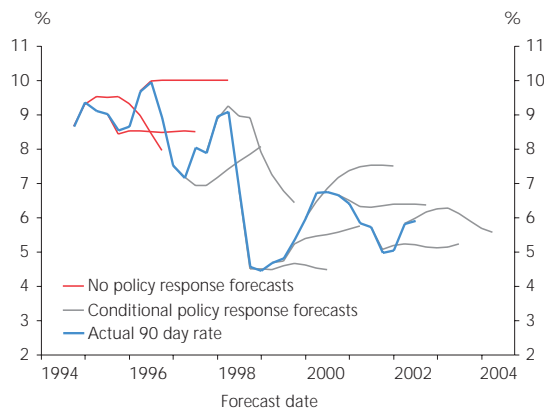
A single numerical projection cannot fully encapsulate the policy-makers' perceptions of risks facing the economy, even though perceived risks are very important for the policy decision. For example, after the events of 11 September 2001 we lowered rates more than was strictly consistent with our numerical forecasts. An average discrepancy between published and actual interest rates could be interpreted as a measure of asymmetric perceptions of risk over the period.

²⁵ "Since the early 1990s, it appears that the pass-through into local prices of nominal exchange rate changes has become more muted, thereby effectively lengthening monetary policy's lags." (Reserve Bank of New Zealand 2001c).

²⁶ Note that, if anything, we have delivered interest rates slightly lower than forecast, on average.

There is some slight (not statistically significant) evidence that, on average, interest rates may have tended to be lower than we have shown in our projections (see table 4, appendix 2). Figure 10 plots the 90 day interest rate and our projected tracks at 3 quarter intervals. While, on average, interest rates have been lower than the published tracks, this is not the case in all quarters.²⁷ The largest errors were made during the Asian crisis plus drought event, which took most forecasters by surprise.

Figure 10
The 90 day interest rate and the Reserve Bank's forecasts (3 quarter intervals)



vii) *Unforeseeable events*

An alternative potential explanation for the CPI forecast bias is that the economy was affected over the sample period with unforeseeable events that happened by chance to increase inflation on average.

We examined this issue in several ways. First, we compared the outlooks given in historical *Monetary Policy Statements (MPSs)* with what actually happened, and also looked at what recent economic developments we said had been unforeseen by us at the time. While there may of course be a tendency for *MPS* commentary to focus more heavily on upward unforeseen impacts on inflation, it does appear that unpredictable and non-demand-related significant price

changes, such as government charges and oil prices, have been positive for inflation, on average, since the early 1990s. Quantifying this is possible only for more recent data.

In a further piece of analysis we excluded from our one-year ahead forecasts sizeable unforeseen developments in the prices of individual items (mainly government policy-induced price changes and petrol prices) since 1997. We found that these had contributed both positively and negatively, and were not a major driver of the bias. (Note, however, that this is a very narrow definition of unforeseen surprises.)

We also compared our historical forecast stories with those of other forecasters. One forecaster who produced superior inflation forecasts to us put a greater emphasis on cost-side variables in their inflation story-telling. On a few occasions their more optimistic economic outlook was more accurate than our own, but in general it seems that 'shocks' such as the Asian crisis plus drought event and administered/foreign prices affected their forecast accuracy in much the same way as ours.

We conclude that, although unforeseeable events may well have contributed to our inflation forecast errors over the past decade, it seems unlikely that they can fully explain our forecast bias.

6 Weighing up the evidence

It appears from the foregoing discussion that the most substantial contributors to our inflation forecast bias have been as follows:

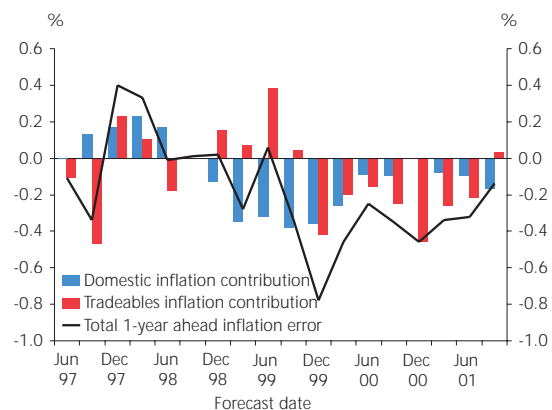
- in the mid-1990s, the predominant issue seems to have been a general over-optimism about how fast the economy could grow without generating inflation pressures;
- since this period, the main issue was probably a large and persistent over-prediction of the level of the exchange rate.

²⁷ A caveat to interpreting these results is the change in forecasting regimes in 1997 and the move to the Official Cash Rate (OCR) in March 1999. Also note that we do not set the 90-day rate analysed here. While the current OCR is an important influence, so too are traders' views on the future path of the OCR, which may differ from our own.

We can also examine the contributions of these two factors in recent years using the FPS model. Although it is only an approximation of reality, the FPS model splits projected CPI inflation into domestic price inflation, driven mainly by the output gap and inflation expectations, and the remainder, driven largely by imported inflation and the exchange rate. At a conceptual level, these roughly correspond to the split between non-tradables and tradables inflation respectively. Using this imperfect corollary we can split our quarterly CPI forecast errors (1 year ahead) into domestic and tradables components (figure 11) for the period for which data are available.²⁸ Findings show that:

- Year-ahead domestic inflation was slightly over-predicted in late 1997 and early 1998 (ie the late 1997 to early 1999 outturns). During these quarters we consider that our estimates of the economy's capacity to meet demand were reasonably accurate (figure 9), but due to the Asian crisis plus drought period we had surprisingly low total growth, and hence a lower than expected output gap.²⁹
- Year-ahead domestic inflation was underestimated over 1999 (ie the calendar 2000 outturns). During this period, our estimates of trend output growth were fairly accurate but we underestimated the gap because we had under-predicted the speed at which the economy would emerge from the Asian crisis and drought-induced slowdown.
- Exchange rate-related factors dominate our December 1999 to March 2001 inflation forecast errors (ie the December 2000 to March 2002 outturns). This is the

Figure 11
Contributions of domestic and tradables inflation forecast errors



period in which exchange rate developments deviated most dramatically from our assumptions.

These findings confirm the importance of our exchange rate technical assumptions in recent years, as discussed above. However, this analysis suggests that much of the domestic inflation forecast error since 1997 appears attributable to economic events, in particular the unforeseeable combined Asian crisis and drought occurrence, rather than to generally flawed estimates of the capacity of the economy to grow without generating inflation. This contrasts with our conclusion regarding the mid-1990s.

7 The inflation forecast bias in context

Our projections are conditional on technical assumptions, externally-sourced forecasts, and prior to 1997, unrealistically static monetary policy assumptions. It is accepted by all commentators that economic outturns will seldom turn out exactly as projected. Additionally, our projections are only one input into the policy-making process, which also depends on a much broader range of information not explicitly captured in our published projections, particularly the perception of risks. Nonetheless, projections are an important input, and they embody a good deal of our understanding of how the economy works.

²⁸ The data are adjusted for “special factors” – ie large unforeseeable movements in the prices of individual items with a significant weight, eg petrol.

²⁹ Although figure 6 shows an under-prediction of the output gap during this time, this is the *starting-point* estimate. Our year-ahead output gap forecasts for this period, for example, were too high.

One reason biased forecasts would be of particular concern is if they reflect a bias inherent in the forecasting methodology or in the policy-makers' understanding of the workings of the economy. Notwithstanding the existence of a forecast bias over the period being investigated, we do not believe that there is a systematic source of bias that is likely to persist into the future. We consider that the period of underestimation of inflation pressures in the mid-1990s (underestimating demand and overestimating the economy's capacity to meet that demand), followed by a period of very unusual and unforeseen exchange rate behaviour, are sufficient to explain the great majority of the calculated CPI forecast bias. Although we will continue to make inflation forecast errors, and they may well be persistently in one direction or another for a period, these particular historical sources of bias are not expected to persist, for the following reasons:

- **Underestimating demand.** While this has been a contributor to our inflation under-prediction at times, over the full sample period we have made errors on both sides, as one would expect with an economy that cycles in ways which are not entirely predictable. Indeed, over the sample period as a whole, it appears that we may have over-estimated GDP growth, if anything.
- **Overestimating the economy's capacity to grow without generating inflation pressures.** Again, this appears to be more period-specific than generic. With progressive learning about the economy's changing structure, one would reasonably expect periods of under- and over-estimation of the economy's capacity to meet demand without generating inflation. And there is evidence of progressive learning having taken place, with earlier over-estimates having given way to a subsequent period with no clear pattern.
- **Exchange rate assumptions.** The issue of the sample period is again relevant. The particular period in which the gap between the exchange rate assumption and subsequent reality was largest, was an episode of surprisingly large and sustained depreciation. We have also experienced a surprisingly large and sustained *appreciation* over the period under review, but we have roughly only half of this episode in our sample period.

Going forward, assuming the methodology remains unchanged, we would expect our exchange rate assumption to be a source of inaccuracy but not bias.³⁰

Biased forecasts are a credibility risk for the central bank as they open us up to criticisms of not having a good understanding of the economy, but most importantly, a forecast bias is of concern if it leads to non-optimal operation of monetary policy. We concluded in our 1999 business cycle review that underestimation of the growth pressures in the economy over 1995-96 led us to tighten policy too late, necessitating a longer, higher cycle in interest rates than would otherwise have been necessary. Therefore, biased forecasts did lead to non-optimal policy on that occasion. However, we are broadly confident that our basic methodology is sound.

Although inflation has sat in the upper part of the inflation target band on average, we do not think it is reasonable to conclude that monetary policy should have been tighter than it was in order to be consistent with the Policy Targets Agreement (PTA). The PTA acknowledges that, *ex post*, inflation outcomes may well be towards the edge or even outside the target range, even if policy settings were intended to produce outcomes comfortably within that range. Moreover, the PTA acknowledges that in some cases, policy should not be set so as to produce outcomes comfortably within the range within the immediate period ahead. We argue that particular sample period events dominate the average inflation forecast bias over the period in question, and that outcomes have been on the whole entirely consistent with the PTA.

To be sure, existence of an inflation forecast bias over a medium-term horizon is not riskless. It is important to ensure that temporary inflation disturbances are not perceived as signalling the existence of an ongoing inflation problem. If inflation expectations creep up because we are perceived to

³⁰ Early evaluation suggests that our current methodology for generating an exchange rate assumption is at least as good – or bad – as any other (in relation to forecast accuracy and bias). And the current methodology has the advantage of being broadly consistent with the idea that over time cycles tend to reverse direction, and that changes in interest rate differentials can matter for exchange rate behaviour. Assuming an unchanged exchange rate at current levels is inconsistent with either idea.

not be committed to fulfilling the targets outlined by the Government in the PTA, then the task of inflation targeting becomes much more difficult, with more painful consequences for short-term growth than would otherwise be the case.

Inflation expectations have followed inflation up in recent years, but no more so than is consistent with changes in the PTA inflation target range. As yet, we have no reason to believe that they will continue to increase, but this is obviously a factor which will require careful monitoring.

8 Conclusion

Even with the benefit of hindsight it can be difficult to establish unambiguously the factors that have influenced the accuracy of our forecasts. We do not have enough data to distinguish between competing explanations with any certainty. However, the analysis points towards the following general conclusions.

- Our CPI forecasts since 1994 have been biased towards under-prediction in the medium term. The largest under-predictions were made in the period 1996-97 and 2000.
- In the mid-1990s, we believe we overestimated the disinflationary impact of the high exchange rate at the time. However, the main drivers of our under-estimates of inflation in the mid-1990s were an underestimation of demand and an overestimation of the economy's capacity to meet that demand without generating inflationary pressures.
- Over-prediction of the level of the exchange rate is likely to have been a major driver of our inflation forecast bias in the period since 2000.
- Contributions have also likely been made at times by an overestimation of exchange-rate pass-through, inaccurate world growth forecasts, GDP revisions and unforeseeable events, but we have no evidence that these factors have contributed significantly to our forecast bias (though they have contributed to forecast inaccuracy).

We will continue to have difficulties with our exchange rate assumptions. So will other forecasters. This is unavoidable,

given the inherently unpredictable nature of the exchange rate. Moreover, because of the tendency for over- or under-estimates of the exchange rate to persist in one direction for a period, they may well contribute to persistent one-sided inflation forecast inaccuracies in particular periods. However, we believe that our method for generating reasonable exchange rate forecasts is as sound as any other, and that any over- or under-estimates of the exchange rate will cancel out over time.

We will also continue to be hit by unforeseeable events which will cause our growth and inflation forecasts to be wrong, perhaps persistently.

With respect to our understanding of economic relationships, this does not appear to have consistently contributed to forecast bias. However, we progressively learn about the structure of the economy, and for now believe we have a more accurate grasp of the following variables:

- the long-run equilibrium exchange rate,
- exchange rate pass-through into CPI inflation, and
- the economy's capacity to grow without generating inflation pressures.

Of course, all of these variables are constantly evolving and it is almost certain that at some stage in the future we will not have an accurate estimate of them for non-trivial periods of time. This reaffirms the importance of constantly reassessing our estimates of how the economy works.

We will continue to review our forecasting accuracy periodically and to use that analysis as part of the ongoing process of improving the Bank's forecasting processes and monetary policy-making capacity.

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Appendix 1: Statistical measures of forecast performance

The mean error (ME) is defined as:

$$\frac{1}{T} \sum_{t=1}^T (F_t - A_t) \quad \text{where } T = \text{number of observations}$$

$F_t = \text{forecast}$
 $A_t = \text{actual outturn}$

The mean error (ME) reflects the overall bias in forecasting. A positive mean error indicates that, on average, the forecasts over-predicted the actual data. Conversely, a negative mean error reflects a tendency to under-predict. We can test whether the ME is statistically different from zero by conducting a t-test:

$$t = \frac{ME}{\sqrt{s^2 / T}} \quad \text{where } s^2 = \text{sample variance}$$

The mean absolute error (MAE) is defined as:

$$\left(\frac{1}{T} \sum_{t=1}^T |F_t - A_t| \right)^{1/T}$$

This cancels out positive and negatives to give a measure of forecast error magnitude, with a lower MAE indicating greater accuracy. The MAE gives equal weighting to forecast errors regardless of their size.

The root mean square error (RMSE) is defined as:

$$\sqrt{\frac{1}{T} \sum_{t=1}^T (F_t - A_t)^2}$$

This is another measure of forecast error magnitude, with a lower RMSE indicating greater accuracy. Unlike the mean absolute error, the RMSE gives a greater weighting to larger forecast errors by squaring the values before taking the mean. This means the RMSE penalises larger errors by proportionately more.

Appendix 2: Summary tables of forecast performance

Table 1
Summary statistics for the Reserve Bank's inflation forecast errors (December 1994 to September 2002)

Quarters ahead	Mean errors		RMSE		Observations
	Annual	Quarterly	Annual	Quarterly	
Current	0.05	0.04	0.27	0.24	32
1	0.00	-0.05	0.45	0.30	31
2	-0.15	-0.14 **	0.59	0.34	30
3	-0.39 ***	-0.21 ***	0.77	0.39	29
4	-0.65 **	-0.23 ***	1.03	0.38	28
5	-0.80 ***	-0.21 ***	1.15	0.37	27
6	-0.88 ***	-0.22 ***	1.23	0.39	26
7	-0.88 ***	-0.22 ***	1.20	0.38	25
8	-0.87 ***	-0.21 ***	1.20	0.36	24
9	-0.90 ***	-0.24 **	1.23	0.40	23
10	-1.01 ***	-0.27 ***	1.32	0.42	20

Notes: Inflation is measured using the CPI adjusted for interest rates. An adjustment is for Housing New Zealand rentals is also included in 2001.

Asterisks indicate the significance with which the null hypothesis: Mean Forecast Error = 0 can be rejected:

*** = Significant at the 1% level

** = Significant at the 5% level

* = Significant at the 10% level

Annual forecast errors for the current quarter and 1 to 3 quarters ahead horizons are not normally distributed. For these horizons we test the null hypothesis: Median Forecast Error = 0.

Table 2
Summary statistics for the Reserve Bank's annual inflation forecast errors: "No policy response" forecasts (December 1994 to March 1997) and "Conditional response" forecasts (June 1997 to December 2002)

Quarters Ahead	Mean errors		RMSE		Observations	
	No policy response	Conditional response	No policy response	Conditional response	No policy response	Conditional response
Current	0.03	0.06	0.15	0.31	10	22
1	-0.02	0.01	0.27	0.52	10	21
2	-0.19 *	-0.13	0.31	0.69	10	20
3	-0.38 **	-0.39	0.52	0.88	10	19
4	-0.62 ***	-0.66 *	0.75	1.16	10	18
5	-0.75 ***	-0.82 **	0.87	1.30	10	17
6	-0.82 ***	-0.92 **	0.91	1.39	10	16
7	-0.76 ***	-0.96 **	0.83	1.40	10	15
8	-0.62 ***	-1.04 **	0.72	1.44	10	14
9	-0.56 ***	-1.16 **	0.72	1.51	10	13
10	-0.54 **	-1.39 ***	0.81	1.62	9	11

Notes: Asterisks indicate the significance with which the null hypothesis: Mean Forecast Error = 0 can be rejected:

*** = Significant at the 1% level

** = Significant at the 5% level

* = Significant at the 10% level

Forecast errors for the 2 quarters ahead horizon during the conditional response period are not normally distributed. For this horizon we test the null hypothesis: Median Forecast Error = 0.

Table 3a

Mean annual CPI inflation forecast errors: Reserve Bank versus Forecaster A (June 1995 to June 2002)

Quarters ahead	RBNZ	Forecaster A	Significant difference
Current	0.06	0.01	-
1	0.02	-0.06	-
2	-0.17	-0.22	-
3	-0.40	-0.26	-
4	-0.72	-0.25	Yes
5	-0.91	-0.15	Yes
6	-0.88	-0.05	Yes
7	-0.85	0.06	Yes
8	-0.73	-0.03	Yes
9	-0.70	-0.09	Yes
10	-1.07	-0.57	-

Table 3b

Mean annual CPI inflation forecast errors: Reserve Bank versus Forecaster B (September 1992 to June 2002)

Quarters ahead	RBNZ	Forecaster B	Significant difference
Current	0.03	0.00	-
1	-0.02	-0.11	-
2	-0.15	-0.28	-
3	-0.33	-0.48	-
4	-0.54	-0.61	-
5	-0.66	-0.65	-
6	-0.72	-0.62	-
7	-0.77	-0.55	-
8	-0.83	-0.50	Yes
9	-0.82	-0.45	Yes
10	-0.87	-0.49	Yes

Notes to tables 3a and 3b:

We test for a difference between the mean forecast error from each organisation using F-tests. Where forecast errors are not normally distributed, we test for a difference in median forecast errors. We examined for the presence of a significant difference at the 10% significance level or better.

Table 4

Summary statistics for the Reserve Bank's interest rate projections: "No policy response" forecasts (December 1994 to March 1997) and "Conditional response" forecasts (June 1997 to December 2002)

Quarters ahead	Mean error		RMSE		Observations	
	No policy response	Conditional response	No policy response	Conditional response	No policy response	Conditional response
Current	0.03	-0.03	0.16	0.15	10	22
1	0.24	0.16	0.75	0.83	10	21
2	0.30	0.25	1.20	1.27	10	20
3	0.35	0.36	1.44	1.61	10	19
4	0.30	0.55	1.57	1.71	10	18
5	0.15	0.75	1.48	1.83	10	17
6	0.26	0.88	1.20	2.04	10	16
7	0.67	0.85	1.42	2.06	10	15
8	1.14	0.75	2.02	1.94	10	14
9	1.46	0.73	2.67	1.78	10	13
10	1.73	0.73	3.24	1.48	9	12

Notes: No mean errors were significantly different from zero at the 10% significant level.

Managing New Zealand's foreign reserves

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New Zealand holds foreign exchange reserves primarily to enable the Reserve Bank to intervene in the New Zealand currency market if serious liquidity problems were to develop. Holding reserves involves balancing a number of factors. We need to have assets that we can readily convert into cash in a crisis. But holding reserves costs money. We want to minimise that cost wherever possible, but we want to do so without exposing the Bank to undue financial risks. Much of this article is about how we balance these considerations and about the framework used to manage the risks associated with our foreign reserves operation. It also discusses our active management approach, undertaken with the objectives of reducing the risk-adjusted cost of holding reserves and enhancing our understanding of financial markets, and the relevant statutory provisions governing foreign exchange intervention and reserves.

1 Introduction

This article discusses the Reserve Bank's management of foreign exchange reserves. Section 2 briefly reviews the rationale for holding reserves in New Zealand. Section 3 explains how we structure our portfolio and describes our formal risk management framework.

2 Rationale for holding foreign reserves

Almost all countries hold foreign reserves, typically managed by the central bank. Many countries hold reserves to enable intervention to support their currency, or to limit currency volatility.¹

New Zealand differs from countries that have used foreign currency reserves to influence exchange rates. Since the New Zealand currency was floated in 1985, we have not intervened in the foreign exchange market despite having maintained the capacity to do so.

A previous *Bulletin* article² discussed the rationale for New Zealand holding reserves. That article concluded that, even for a country with a free floating currency, such as with the

New Zealand dollar, foreign reserves are necessary for three main reasons:

- The most important reason is that reserves provide an important policy option if New Zealand were ever to experience serious liquidity problems in its foreign exchange market. By helping to provide liquidity and restore order, foreign exchange intervention might help to limit the damage to the economy. The cost of holding foreign reserves is akin to the premium homeowners pay to insure their houses against fire. In both cases, the main financial benefit is realised only in rare and adverse circumstances (indeed, hopefully not at all).
- Investors may use a country's holding of reserves, at a reasonable level, as a crude proxy for financial health. Certainly, no country has chosen to hold none. Reserves may improve the perceived creditworthiness of New Zealand and thereby lower borrowing costs for its borrowers and increase foreign investor confidence in New Zealand.
- By managing reserves the Bank benefits from practical market experience and an enhanced understanding of financial markets, which is beneficial both in conducting monetary policy and in fulfilling the Bank's financial stability responsibilities.

The legislative authority relating to the Bank's reserves and foreign exchange intervention is covered in the box overleaf. That box also discusses the role of the Minister of Finance and shows the level of reserves that have been held over the last ten years.

¹ Other motivations may include: acting as a liquidity buffer in the event of a national emergency, improving resilience to meet crises arising from domestic or external shocks, meeting government foreign currency obligations, and acting as an investment fund to enhance national wealth.

² 'The rationale for holding foreign currency reserves,' Reserve Bank of New Zealand Bulletin, David Archer and Jerse Halliday, Vol 61 No 4.

Legislative authority, the role of the Minister and the level of reserves

Part II of the Reserve Bank of New Zealand Act 1989 (the Act) sets out some of the Bank's functions and powers. Some key sections relevant to foreign reserves and intervention are:

- *Section 16* gives the Bank authority to deal in foreign exchange. This section provides the Bank with broad powers to deal, as it thinks fit, in order to perform its functions and fulfil its obligations under the Act.
- *Section 17* gives the Minister of Finance (the Minister) power to direct the Bank to deal in foreign exchange, for the purpose of influencing the exchange rate or exchange rate trends. When such a direction remains in force, all foreign exchange dealing by the Bank must comply with this direction, notwithstanding the Bank's powers under Section 16.

The Minister has given the Bank a direction to cover the possibility that a crisis could appear in the market suddenly and the Minister could not be contacted. Under these circumstances, the Bank is directed to intervene if urgent action is required. In all circumstances the Minister would be briefed as soon as possible.

- *Section 18* gives the Minister power to fix exchange rates for foreign exchange dealing by the Bank.³
- *Section 21* makes the Crown (New Zealand Government) incur any foreign exchange gains or losses arising from directions by the Minister under section 17 or section 18.
- *Section 24* contains provisions relating to the level of foreign reserves. This section gives the Minister the

³ Section 19 deals with circumstances in which the Governor of the Bank may consider the Minister's directions under section 17 or section 18 to be inconsistent with the Policy Targets Agreement set under section 9 of the Act. The Governor is given the power to request new monetary policy targets to be fixed.

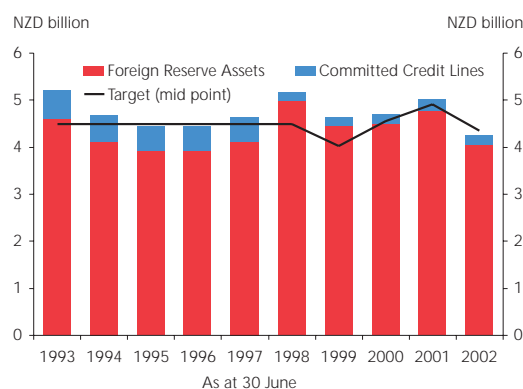
power, in consultation with the Bank, to determine the foreign reserves level or range.

In accordance with Section 24 of the Act, the Minister has specified a target range for the Bank's foreign reserves. This target range is specified in terms of an intervention capacity, which includes a modest committed credit line with the Bank for International Settlements.

The current range is specified in terms of a notional foreign currency, known as a Special Drawing Right (SDR), which is calculated in reference to a composite basket of major foreign currencies.

The target range has been set at SDR 1.45 billion to SDR 1.75 billion (which at current exchange rates equates to around NZ\$3.9 billion to NZ\$4.8 billion). Over recent years, the intervention capacity has generally been close to the mid-point of SDR 1.6 billion (NZ\$4.4 billion at current exchange rates). The graph below illustrates the intervention capability expressed in New Zealand dollars over the last 10 years versus the prevailing target midpoint.⁴

Figure 1
Level of foreign reserves



The level of reserves has remained largely unchanged since the late 1980s. The Bank has recently initiated a review of the suitability of the current level of reserves.

⁴ The level of reserves in this graph is less than those shown in the International Financial Statistics of the International Monetary Fund, as the IMF statistics include assets held (not for intervention purposes) by the New Zealand Treasury.

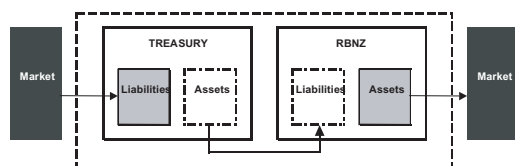
3 Structuring our portfolio

Given the policy decision to hold reserves, there are a number of important choices the Bank needs to make. Broadly, these reduce to balancing a desire for liquidity with a wish to keep the cost of holding reserves to a minimum, all without exposing the Bank to undue risk.

3.1 Borrowing to fund foreign reserves

The Bank funds foreign reserves by borrowing in foreign currencies from the Treasury, which borrows the funds it on-lends to the Bank (see figure 2). This approach helps to facilitate the Crown's management of its consolidated asset and liability exposures.

Figure 2
Funding the Bank's foreign reserves



The Bank's approach of borrowing in foreign currencies to fund reserves differs from that of most other central banks⁵, and has an important bearing on how we structure the composition of reserves we hold. We greatly reduce our exposure to market risk by matching up the interest rate and currency exposures of our reserve assets and funding liabilities. This approach virtually eliminates our exposure to currency movements and changes in the level of interest rates, but leaves us exposed to the spread between investing and borrowing rates.

Holding liquid reserves typically costs money. The cost of holding reserves becomes transparent when reserves are funded by foreign currency borrowing. The analogy of a householder having a mortgage and a credit balance in a cheque account illustrates the point. For the Reserve Bank, the interest rates paid on financing reserves will typically be greater than the interest rates we can earn by investing in highly liquid low risk assets in the world's major markets.

Funding reserves from foreign currency borrowing does have a potential downside. To maintain continuity of reserve holdings, maturing loans must be refinanced. The risk that a market disruption could impair the Bank's refinancing ability is managed by ensuring that loan maturities are adequately spread out over time.

3.2 Need for liquidity

The rationale for holding foreign reserves influences the type and nature of the reserves held.

The need to be able to restore order in the event of a crisis is a key determinant. Financial crises, by their nature, can occur with little or no warning. For example, a surprise event such as a major earthquake in New Zealand could adversely affect the liquidity of the New Zealand currency market. An outbreak of foot and mouth disease could be another potential cause, given the importance of agricultural exports to the New Zealand economy.

Since the float of the New Zealand currency, intervention has been conceived as occurring primarily in cases of "extreme disorder" in the currency market. This means that we cannot count on international markets functioning smoothly when we need to liquefy reserves.

For these reasons all our reserves are held in secure and highly liquid assets – assets that can be sold or lent out quickly at minimum cost, even in troubled times abroad.

If a financial crisis were to emanate from overseas, say from a terrorist attack or a technology outage, the effects might be concentrated in a particular country or exchange market. The Bank therefore requires adequate diversification of its

⁵ Reserves must be funded in some manner, as a central bank's assets must equal liabilities. As alternatives to borrowing in foreign currencies, reserves may be funded from domestic currency issuance or banks' holdings of settlement account balances at the central bank.

asset holdings across countries and types of security issuer, so that at least some reserves could be liquefied in a range of possible scenarios.⁶

3.3 Managing foreign reserves

In managing foreign reserves, the Bank aims to be able to meet the liquidity needs for any intervention in the New Zealand currency market. Subject to this over-riding objective, the Bank seeks to lower the net cost of holding reserves.

The Bank is also concerned about the year-to-year variability in this cost, which represents a risk – the greater the year-to-year variability in costs, the greater the potential for an adverse result in any given year.

There may be trade-offs between lowering the net cost of holding reserves and lowering the variability in this net cost. The Bank has therefore adopted an objective which combines risk and return into a single measure – reserves are actively managed in order to minimise the risk-adjusted net cost of holding reserves. This objective is equivalent to maximising the risk-adjusted net return.

The bulk of the Bank's reserves are held in the United States or Germany in a range of different financial instruments issued by public and private sector entities. We used to hold a portion of reserves in Japanese government bonds. This portion has been reallocated into the United States and German markets over the last couple of years due to growing concerns about Japan's economic difficulties.

We do not hold reserves in Australia or Asia given the possibility that a financial crisis affecting the New Zealand currency may arise as a result of a shock affecting the region. When deciding which reserve assets to hold, we, like other central banks, aim to hold assets whose value and liquidity will be affected as little as possible by shocks affecting the local market.

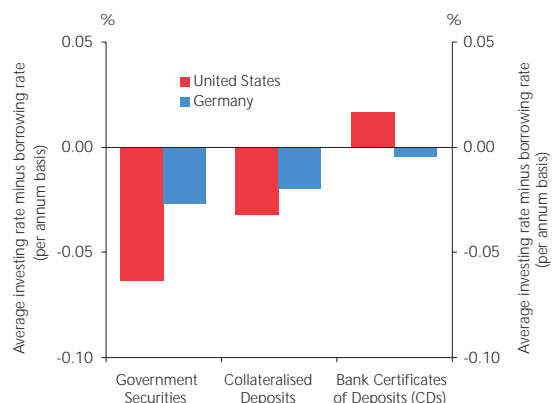
Most of our reserves are held in the following:

- United States or German government securities, such as bonds or Treasury Bills.
- Deposits with banks, denominated in US dollars or euro, where United States or German government securities are provided as collateral.⁷ This collateral provides protection in the event of default. Although bank deposits are generally not broken before maturity, we can readily raise cash in the interim by using the collateral held.
- Certificates of Deposit (CDs), issued by banks, denominated in US dollars or euro. These are marketable securities that can be on-sold before maturity. The small size of the Bank's holdings, relative to the size of the CD market, provides comfort that these securities offer adequate liquidity. Nevertheless, we consider CDs to be our least liquid "tier" of reserves and hold these on top of specified minimum holdings of government securities and collateralised deposits.

If liquidity were the only consideration, we would only hold government securities. If cost were the only consideration, we would only hold higher yielding assets, such as CDs. In practice, we strike a balance between these considerations by holding a mix of assets.

The following graph shows indicative borrowing costs over the year to 30 June 2002, for investments with a period to

Figure 3
Indicative borrowing costs



⁶ By holding reserves in a form that can be used in the event of a serious liquidity crisis we do not compromise our ability to implement any other approach to intervention the Minister of Finance may direct. For example, in normally functioning markets intervention may be financed in the foreign exchange swaps market - as the Reserve Bank of Australia typically does - without liquidating assets at all.

⁷ Although these are referred to as collateralised deposits in this article, technically they are reverse repurchase agreements. Under this arrangement the Bank has clear title to the securities and can use them freely before the maturity of the arrangement.

maturity of 3 months. The costs represent the average difference between the interest rate received from each type of investment, and the corresponding interest rate paid by the Bank on its funding. The more negative this difference, the greater the cost.

As this graph shows, government securities generally cost more to hold than collateralised deposits, and collateralised deposits cost more to hold than CDs. This reflects the lower rate of return generally obtained on government securities than on some other financial instruments, due to the lower credit risk associated with government securities.

The Bank imposes limits in order to strike a balance between minimising costs and maintaining adequate liquidity, security and diversification. These limits specify minimum holdings, but provide some discretion to respond to pricing considerations. Discretion applies to different types of investments in one currency and also to the choice between investing in the United States or Germany. For example, US Treasury Bills normally cost the Bank more to hold than collateralised US dollar loans. When this has not been the case we have responded by increasing our holding of Treasury Bills and reducing our holdings of collateralised deposits.

Over the years, we have sought opportunities to use different types of investments with a view to lowering risk-adjusted costs. For example, we hold a portion of euro denominated assets in medium-term investments issued by the Bank for International Settlements.

Earlier this year, the Bank shifted from holding longer-term US government bonds to holding short-dated US Treasury Bills. The corresponding loans were converted from a fixed rate to a floating rate basis at that time. We expect that over time, this change will help lower the average cost of holding US government securities. This change will also significantly reduce the year-to-year variability in our cost of holding reserves. This variability arises because the Bank has an accounting policy of revaluing assets to their current market value. The reason this variability has been reduced is that valuation changes diminish when interest rate exposures apply to a shorter period.⁸

⁸ The Bank views the expected reduction in average costs as the most important consideration. This is because the Bank typically holds reserve assets to maturity, in

3.4 Avoiding undue risk

To ensure that the Bank is not exposed to undue financial risk as a result of holding reserves we make three strategic choices:

- we finance the reserves by foreign currency borrowing;
- we match up the currency mix of our assets and liabilities (therefore reducing the risk of exchange rate loss); and
- we limit how much exposure we have to any issuer or counterparty (therefore reducing the risk of loss associated with the default of an issuer or counterparty).

Foreign exchange risk can be all but completely eliminated. Interest rate risk can be substantially reduced (the residual impact is discussed in the following section), so that our largest single risk is the probability of default by an issuer (ie credit risk).

3.5 Costs of holding foreign reserves

The costs of managing foreign reserves are shown in the Bank's Annual Financial Statements.

Some of the costs arise because the Bank must provide a range of services in order to provide this function. These include:

- operating costs directly associated with the management of reserves; and
- operating costs for other services that can be attributed to supporting the management of reserves, such as:
 - risk management;
 - settlements;
 - governance and oversight; and
 - accounting.

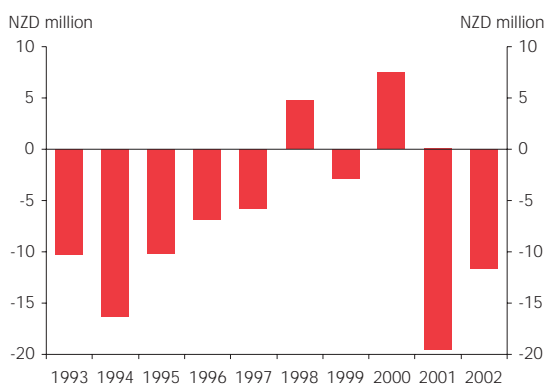
In total, the operating costs required to maintain the foreign reserves function have averaged \$1.8 million a year over the ten years to June 2002. This cost represents around 0.04 per cent of the average value of the foreign reserves held over this period.

which case the average cost of holding long-term bonds is "locked in" at the time of purchase, regardless of subsequent valuation changes.

Additional to these operating costs are the holding costs that arise because reserves usually cost more to fund than the earnings they generate. These holding costs have not been constant from year to year, mainly due to revaluation changes. These revaluation changes reflect incomplete matching of asset and liability exposures – in particular, changes in the spread between borrowing and lending rates.

The following graph shows the net returns from holding foreign reserves over the last ten years, excluding the impact of active management decisions, operating costs and risk charges. In this graph a negative net return equates to a cost of holding reserves.

Figure 4
Net returns from holding reserves



The average annual cost of holding foreign reserves shown in the above graph is \$7.2 million per year. This equates to around 0.15 per cent of the average value of the foreign reserves held over the period. The cost over the second half of this ten year period (0.09 per cent) was lower than over the first half (0.21 per cent).

3.6 Active management

The Bank undertakes a modest amount of trading in markets, based on expectations about future movements in interest rates and currencies.⁹

⁹ We have firm rules in place to limit trading in New Zealand markets and especially around Official Cash Rate (OCR) release dates.

For example, we seek to add value in exercising discretion relating to the timing of borrowing, and the period to maturity. These decisions are made in consultation with the Treasury. Another example is our recent use of a derivative security known as a bond index swap. Under this arrangement, we hold a portion of reserves in longer-term German government bonds, but receive returns linked to a floating rate benchmark. We expect this arrangement to cost less than the alternative of holding short-dated German government bonds.

To ensure accountability, we monitor and report the success or otherwise of active management decisions to the Governor, senior management and the Bank's Board of Directors. To identify the impact of active management decisions, we maintain a notional portfolio established using pre-defined rules. This notional portfolio represents a benchmark against which performance can be measured. To allow for the incremental risk arising from active management, risk charges are applied to the returns attributable to active management.

Much of the Bank's active management represents short-horizon or "trading" positions. To ensure the resulting profit and loss impact of these trades can be monitored, they are accounted for within a separate "portfolio". The activities within this trading portfolio generate interest rate and currency exposures limited by various constraints imposed by the Bank's overall risk management framework (which will be discussed in more detail in a subsequent section). In engaging in this activity, we seek to reduce the risk of losses by diversifying across the:

- types of exposures taken;
- time horizon over which positions are taken; and
- approaches used to generate positions.

One example of this diversity in approach is the use both of decisions made by individuals and also quantitative trading systems.

The Bank's active approach to management distinguishes it from some central banks, which for various reasons avoid taking active management decisions.

While our experience suggests we can add value through

active management, the Bank does not take this for granted and keeps its approach to the management of foreign reserves under review.

Over the ten years to June 2002, the value added from active management has averaged \$0.85 million per annum, net of all costs and risk charges attributable to active management.¹⁰ However, the value added over this period has not been even and the performance was generally worse over the latter half of this period. The Bank's experience may reflect a change in the environment for active interest rate and currency management. Investment surveys indicate that, as a group, global bond managers had a similar deterioration in performance over the latter half of this ten-year period.

Some central banks use external managers to manage a portion of their external reserves. Although not opposed to this idea in principle, we have not used external managers to date because we have not judged that doing so is likely to be cost effective.

The Bank does use an external party to run a securities lending programme. This programme allows the Bank to earn additional income by lending out securities that are in particular demand and investing the proceeds at higher yields, subject to specified exposure limits, without compromising the liquidity we need for intervention purposes.

3.7 The formal risk management framework

Holding and managing foreign reserves exposes the Bank to a range of risks, which are managed by a combination of:

- suitable governance arrangements;
- a framework which defines key risks, sets limits to control them, and monitors compliance; and
- transparent reporting of results and processes.

3.7.1 Governance

The Bank's powers, authorities and accountabilities are prescribed in the Reserve Bank of New Zealand Act 1989. The Bank's powers and authorities are vested in the Governor, who delegates appropriate authorities to relevant staff. The Bank conducts foreign reserves operations in accordance with a mandate from the Governor. This mandate, which has been in place since September 2000, specifies:

- the purpose of reserves management;
- objectives;
- the level of reserves;
- performance expectations;
- risk management policies; and
- key management responsibilities and delegations.

The Head of Financial Markets is accountable to the Governor for the performance of the Foreign Reserves Group (responsible for the management of the reserves) and Risk Unit (responsible for advice on the risk framework used for foreign reserves). The Chief Financial Officer heads the Financial Services Group, which is responsible for "back office" operations such as settlements, financial accounting, and also for risk and exposure reporting.

Other departments and committees also play an important role:

- The Risk Assessment and Assurance Department (RAA) participates in high level strategic reserves management issues, acting as the Governor's adviser on risk frameworks across the Bank's activities. This department also contains an internal audit function.
- The Reserves Oversight Committee (ROC), which is made up of the Governor, Deputy Governor and senior managers, reviews the appropriateness of the reserves portfolio structure, approves the use of new types of investments, and monitors investment performance.
- The Risk Management Committee (RMC), which is made up of Governors and senior managers, reviews the risk management arrangements in respect of all the Bank's operations, including reserves management.

¹⁰ The operating costs attributable to active management were \$1.9 million per annum over the period. These costs are additional to the operating costs identified under Section 3.4. The Bank's Financial Statements show the combined operating costs in the Consolidated Statement of Cost of Services.

The Bank's Board of Directors (largely non-executive) advises the Governor with respect to matters relating to the Bank's functions and the exercise of its powers. Management reports to the Board monthly on the financial results of reserves management. The Board's audit committee, which is chaired by a non-executive director, also meets regularly and monitors audit and accounting matters relating to reserves management.

3.7.2 *The Bank's risk management framework*

A summary of the key risks, and how the Bank manages these risks is as follows:

- *Political risk* represents the risk of damaging the Bank's reputation by making losses from investing in shares, complex investments, or in less developed markets. To manage this risk, investments are restricted to "plain-vanilla" interest rate investments, and some derivatives. At present, we restrict derivative exposures to interest rate futures, and currency and interest rate swaps. No investments are permitted outside developed countries and markets.
- *Liquidity risk* represents the risk that reserves could not be liquefied as rapidly as needed for intervention purposes. To manage this risk, we hold only liquid assets and we apply limits specifying minimum exposures by country and security type. These limits require not less than one third of the reserves to be held in government securities, and not less than two thirds in a combination of government securities, collateralised deposits and investments with the Bank for International Settlements (with Certificates of Deposit issued by banks confined to the balance).
- *Credit risk* represents exposure to default, bankruptcy, and marked-to-market losses associated with any perceived deterioration in creditworthiness. This risk applies to entities we invest with (for example CD issuers) and also the entities used to facilitate investment transactions.

Credit risk is managed within a ratings-based limit framework. This approach forces diversification and ensures an automatic response to changes in

creditworthiness. Exposure limits specify maximum exposures to individual entities, based on long-term credit ratings. These limits are calibrated so the exposure to any non-government entity is limited to the Bank's capital. The maximum limit permitted for non-government entities with the highest credit rating is \$350 million, but limits are scaled down for entities with lower credit ratings. Exposures are not permitted to entities with a rating below A-. Limits also apply to groups of exposures, such as entities within the same country.

- *Market risk* represents exposure to changes in the market value of investments. The market value of investments can vary, due to changes in interest rates and foreign currency values. The Governor has specified a tolerance for loss from market risk of not more than \$50 million from active management and \$50 million from underlying (benchmark) exposures in any financial year.¹¹ These "worst case" tolerances include times of extreme global financial market crises.

To keep maximum losses within the Governor's tolerance range, the Bank imposes limits based on a statistical measure of exposure to market risk. These limits are based on a widely used measure known as Value at Risk (VaR). Separate limits apply to the total portfolio and also to relevant sub-components.

The Bank recognises that, in extreme events, losses can be many times the losses generated in more normal conditions. The Bank has therefore built a significant "safety factor" into the levels chosen for its VaR-based limits. The safety factor has been chosen after consideration of extreme financial market stress scenarios.

"Stop loss" limits close down trading positions if aggregate losses from these activities exceed \$9 million in any rolling 20-day trading period. It is then up to the Governor to decide whether positions are to be re-established.

¹¹ **The Bank is less concerned about valuation changes that represent an increase in costs now, but imply lower costs in the future if assets are held until maturity. This does not apply to losses from active management where there is no expectation that losses will be recouped in the future.**

-
- *Operational Risk* represents the risk of losses due to a failure to maintain continuous intervention capacity, or losses due to fraud, error or oversight. In order to maintain continuous intervention capacity, the Bank maintains processes relating to data integrity, disaster recovery planning (including offsite capacity), and key person risk.

The Bank has in place a number of operational controls to minimise the financial and reputational damage from fraud. These include:

- separation of front and back office functions;
 - logged dealer phones;
 - tracking of deal tickets;
 - transaction and position reconciliation across profit and loss, and risk reporting; and
 - confirmation and settlement instruction matching with counterparties.
- *Refinancing risk* is the risk of the Bank experiencing disruption when rolling over maturing loans. To mitigate this risk, the Bank limits the concentration of funding requirements in any twelve month period.

The Bank's risk management framework is subject to regular review, including by the Bank's RAA department. External audit also provides a further layer of review, as does the regular monitoring by the Bank's non-executive directors.

4 Conclusion

Although the Bank has not intervened in the New Zealand currency market since the New Zealand dollar was floated in 1985, it has maintained the capacity to do so. In managing foreign reserves, the Bank must meet its overriding objective of being able to meet the liquidity needs for any intervention.

There are good public policy reasons for holding reserves and the management of reserves is an important function for the Bank. To support this function, the Bank provides a range of services. These cover the spectrum, from governance and oversight through to settlements and accounting.

In managing its reserves, the Bank strikes a balance between maintaining liquidity and minimising costs. The Bank has been successful in finding ways to reduce holding costs by restructuring assets and utilising new instruments.

Holding and managing foreign reserves exposes the Bank to a number of significant risks. The Bank has implemented a sound structure to manage and control these risks.

Corporate behaviour and the balance of payments

Leslie Hull, Financial Markets Department¹

Balance of payments data are sometimes used to try to predict currency or financial crises. A high current account deficit relative to GDP, a large proportion of external debt relative to equity flows, and a large proportion of investment portfolio flows versus longer-term debt or direct investment have been considered “warning signals” of potential impending financial crises in some economies. Using balance of payments data for these purposes suggests the need for a careful understanding of what underlies the data.

This article aims to further our understanding of some of the elements in New Zealand’s balance of payments current account and financial account data so that we can make more insightful interpretations of developments in the balance of payments. It provides several examples of how corporate financing choices could affect measured flows. Because of legal arrangements, certain corporate transactions may result in the overstatement of one type of capital flow relative to another in economic terms. Therefore, analysis of capital flows at face value could be misleading when interpreting the flows from a macro-financial stability perspective.

1 Introduction

This article describes how various corporate financing decisions affect the balance of payments. Because of the way balance of payments statistics are compiled, they sometimes do not adequately capture the true economic nature of the transaction. Therefore, interpreting these statistics in a financial stability context requires care. Section 2 provides an overview of the balance of payments statistics and the relationship between the composition of capital flows and macro-financial stability. Section 3 describes several corporate financing possibilities and shows how financing decisions affect the balance of payments categories. Section 4 outlines three specific issues that could affect New Zealand’s balance of payments statistics. Section 5 concludes.

2 The balance of payments statistics and macro-financial stability

In the latter half of the 1990s, in response to several currency and financial crises, a large number of studies tested the ability of various economic variables to predict a financial crisis.² The maturity structure of debt was found to have some predictive power, where a high share of short-term debt relative to foreign currency reserves was an indicator of potential financial instability. The split between debt and equity also had implications for potential instability, where highly leveraged firms were seen to be more vulnerable than their unleveraged counterparts. Debt liabilities are prone to maturity or currency mismatch unless hedged, and hedging requires the existence of counterparties willing to hold the interest rate or currency risks. Equity, on the other hand, is repaid only after a full discharge of debt obligations, and dividends generally do not represent contractual obligations but are paid depending on the level of profit. Therefore, when looking at the composition of private capital inflows, a high level of debt versus equity, or debt versus foreign currency reserves, can be a warning sign. These indicators are only suggestive, often predicting crises that do not occur.

¹ The author thanks Margaret Austin, Rochelle Barrow, Anna Bray, Áron Gereben, Bernard Hodgetts, Salendra Kumar, Geof Mortlock, Michael Reddell, Peter Roche, Bruce White, and Ian Woolford for helpful comments and assistance.

² See Hawkesby (2000) and Woolford (2001) for a discussion of macro-prudential indicators.

Therefore, analysing capital flow data requires a case-by-case interpretation.

Data on capital flows, along with trade flows, are found in the balance of payments statistics. Data on the stock of international assets and liabilities are published in the international investment position statistics. The statistics are published by Statistics New Zealand on a quarterly basis. The balance of payments data are compiled on the basis of international standards for national accounts data and consist of three accounts: the current account, the capital account, and the financial account.³ The current account balance reflects "current expenditure" and is the sum of the balance on goods, services, income, and current transfers in a given period. The capital account primarily records cross-border capital transfers. The financial account records the financial transactions associated with the transactions in the current and capital accounts as per double entry accounting. Accordingly, the balance of payments accounts are structured, by definition, to sum to zero, as transactions in

the current and capital accounts have offsetting financial transactions.⁴ This article refers mainly to the financial account and the income portion of the current account. Data for the years ended March 2000 - 2002 for New Zealand are presented in table 1.⁵

Purchases and sales of financial assets of a foreign entity are recorded in the financial account and contribute to the stock of international assets and liabilities, which are recorded in the international investment position data. The income flows from the ownership of foreign assets are recorded in the income category of the current account (see figure 1). Each of these accounts is disaggregated into broad categories including direct investment, portfolio investment, and other investment. Further breakdowns within categories are available. For example, direct investment is broken down into equity capital and other capital, and portfolio investment is broken down into equity securities and debt securities.

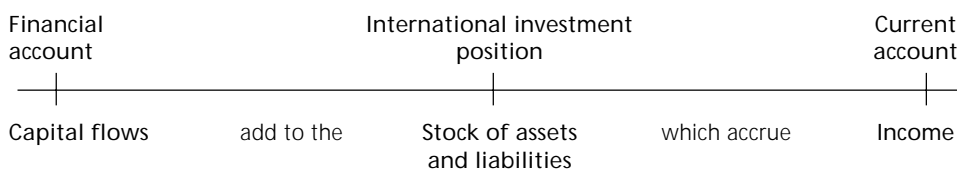
Direct investment is defined as the purchase of 10 per cent or more of a firm's outstanding shares and implies a lasting

Table 1
New Zealand's balance of payments, NZD billions

March years	Current account balance	Financial account balance	Capital account balance	Net international investment position
2000	-7.1	4.2	-0.4	-87.1
2001	-5.3	5.4	-0.2	-85.0
2002	-2.7	5.0	1.4	-92.3

Source: Statistics New Zealand

Figure 1



³ See St Clair, Tether, and White (1998) for a detailed overview of the balance of payments statistics.

⁴ In practice, through a combination of misreporting, measurement difficulties, and the like, the accounts will not sum exactly to zero and usually include reconciliation terms (known as "errors and omissions").

⁵ See Collins, Nadal de Simone, and Hargreaves (1998) for an overview of the factors affecting New Zealand's current account.

interest in the firm and a degree of management control. All subsequent transactions between the direct investor and direct investee are also included under direct investment.⁶ Portfolio investment includes equities and debt securities. Portfolio equity transactions are those that represent less than 10 per cent of a firm's outstanding shares (and that do not result in a firm reaching the 10 per cent ownership threshold). Portfolio debt investment includes both long-term (bonds and notes) and short-term (money market instruments) issues by the banking sector, other corporates, and the government. The government is usually the largest contributor to New Zealand's portfolio debt liabilities. The "other investment" category includes loans, deposits, trade credits, and other liabilities.

3 Corporate financing decisions and the composition of capital flows

The balance of payments statistics are compiled according to internationally recognised standards. Balance of payments data, in combination with data on external assets and liabilities, provide a useful framework for assessing aspects of an economy's economic wellbeing, including the extent to which the residents of a country are collectively earning more or less than they are spending, the level of debt owed by residents to non-residents, the risk profile associated with that debt, and the capacity to service the debt. However, the data need to be interpreted with considerable caution, especially given the - at times - arbitrary dividing line between "resident" and "non-resident", measurement difficulties, and, increasingly, the conceptual difficulties in drawing clear boundaries on financial transactions between people and entities in different countries, given the increasing extent of globalisation, and the ease with which people, entities and assets and liabilities can move across national borders.

⁶ For the banking sector, Statistics New Zealand distinguishes between permanent debt, which represents the long-term investment in the New Zealand subsidiary, and funds used for bank funding. The former is categorised as direct investment while the latter is recorded under portfolio or other investment.

In this context, using the balance of payment statistics to make economic inferences can provide misleading results in some situations. For example, some capital flows categorised as debt because of accounting standards⁷ and legal issues may, from a financial stability perspective, behave more like equity. This section describes various corporate funding arrangements⁸ and how these arrangements are recorded in the balance of payments, with an emphasis on how the resulting composition of flows appears from a financial stability perspective.

Holding companies

A foreign entity wishing to make a direct investment in New Zealand will sometimes set up a holding company in New Zealand. It will issue debt to the holding company, which will then proceed to purchase shares in a New Zealand entity. There are various reasons why firms would want to do this - one of which is tax minimisation. This practice is understood to have been widespread in New Zealand until a change in the tax law ("Thin Capitalisation Rules" contained in Part FG of the Income Tax Act 1994) removed the incentive to organise businesses in that way.

The establishment of the holding company would be recorded as a small foreign direct investment inflow under the equity category in the financial account. The subsequent debt issue would be recorded in the debt category of direct investment in the financial account for the amount of the loan. When the holding company purchases shares in the New Zealand entity with the funds from the debt issue, the transaction does not appear in the balance of payments statistics, as it is not a cross-border transaction. The income that accrues to this arrangement will be recorded under "income from debt" in the direct investment category of the income portion of the current account. If the parent had purchased the New Zealand entity by directly purchasing shares, the transaction would have been recorded in the equity component of direct investment in the financial account. Therefore, the economic substance of these flows

⁷ Statistics New Zealand compiles the balance of payments statistics according to internationally recognised standards.

⁸ Throughout this paper the corporate sector includes the banking sector as well as non-bank financial institutions.

is equity, but the legal form is debt. Balance of payments and international investment position statistics are organised on a legal form basis. From an economic standpoint, therefore, they have probably overstated the share of debt in the international investment position and in the associated income in the current account, particularly in the early 1990s.

Intercompany loans

There are several ways that firms can lend money to their subsidiaries in foreign countries, and the particular form of the funding arrangements evolves according to the specific situation. One type of loan arrangement is a parallel loan, which is best described by way of an example. Suppose corporation A is domiciled in country A and corporation B is a country B entity. With a parallel loan, corporation A will make a loan to corporation B's subsidiary in country A and corporation B would make a comparable loan to A's subsidiary in country B. These types of loans tend to be made to circumvent exchange controls, (which is not applicable in New Zealand's case, given the absence of exchange controls), avoid exchange rate risk, or to achieve favourable interest rates. This type of arrangement will not be recorded in balance of payments statistics, as both parties to the loan are domestic residents in each country. This does not affect the net figures; if the loans were recorded, the inflow would equal the outflow, resulting in a zero net flow. What does result is a reduction in the gross flows in the financial account as well as the interest payments on both sides of the current account. However, given that this type of arrangement is not thought to be common in New Zealand, it would not materially affect recent New Zealand balance of payments statistics.

Flows through New Zealand

The operations of a company, and the location of the parent and its subsidiaries, can have an impact on a country's balance of payments statistics. Consider a New Zealand-based parent that borrows internationally (from an unrelated party) on behalf of its subsidiary located abroad. The initial debt from abroad would be recorded as a financial inflow in the "portfolio" or "other" categories of the financial account (depending on the type of borrowing undertaken). When the parent lends the money to its subsidiary, it would be an

outflow in the "direct investment" category of the financial account. Thus, net flows in the financial account are not affected; the outflow exactly offsets the inflow. However, the levels of the flows in the financial account are inflated; if the subsidiary had borrowed on its own, there would not have been an inflow or an outflow. In addition to the inflation of the levels, there is an effect on the composition of the financial account. This arrangement will increase the share in total of foreign investment from abroad in the "portfolio" or "other" categories as well as increase the direct investment share in the New Zealand investment abroad category.

This arrangement has a similar effect on the income balance of the current account. If the subsidiary had arranged for the financing itself, there would be no entries in New Zealand's current account. With this arrangement, the interest on debt from the subsidiary is classified as "income from investment abroad – direct investment" in the current account, and the interest payments to the outside lender would be in the "income from foreign investment in New Zealand – 'other' or 'portfolio'" in the current account. The amounts should be offsetting so that the net effect on the current account would be zero. Similarly, principal repayments are included in the financial account and will be offsetting. Flows through New Zealand are likely to be relatively less important now than when large corporates with extensive international operations, such as Brierley Investments and Lion Nathan, were headquartered here, and Fletcher Challenge operated as a New Zealand conglomerate.

Some New Zealand entities borrow from their overseas parents. When this occurs, the initial debt transaction results in a capital inflow in the "direct investment" portion of the financial account. The subsequent interest payments are recorded in the "income from foreign investment in New Zealand (direct investment)" portion of the current account and the principal repayments are recorded in the "direct investment outflows" portion of the financial account. To the extent that the New Zealand entity needed to borrow abroad, the fact that the funding is from the parent entity does not affect the level of the current account, only the category the obligation is recorded in. The result is an increase in the share of inward direct investment at the expense of inward investment in the "portfolio" or "other" categories in the financial account.

4 Some numbers for New Zealand

This section provides an analysis of three aspects of the composition of New Zealand's financial and current accounts. First, New Zealand has high foreign direct investment relative to gross domestic product as compared with other countries. Second, as recorded in the balance of payments, New Zealand's returns from investment abroad are significantly lower than the returns to foreigners investing in New Zealand. Third, a significant portion of New Zealand's external debt is owed to related parties. Foreign bank ownership plays a significant role in this regard, given that any funding that the bank subsidiaries are receiving from their parents, as well as any debt relating to the initial purchase of the New Zealand banks, will be categorised as "debt due to related entities". Each of these issues is discussed in turn, with an emphasis on the implications for financial stability.

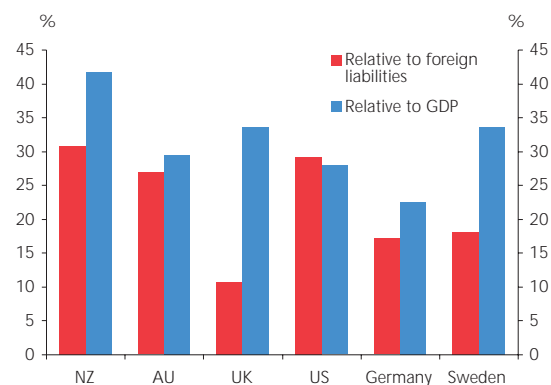
Foreign direct investment

Foreign direct investment (FDI) represents just over 30 per cent of the stock of foreign financing in New Zealand. This is a little higher than the norm for advanced economies (and, of course, in total, New Zealand is more dependent on foreign financing than other developed countries). On the face of it, New Zealand's higher level of inward FDI is a positive feature from a financial stability perspective, given the presumed stability of FDI in periods of economic difficulty (relative to short-term debt). Cross-country comparisons of this data can be misleading however, without taking into account country-specific circumstances. The United Kingdom provides a good example of this. The data indicate that a very low share of foreign liabilities is in the form of direct investment which, if FDI were considered a "safer" form of financing from a macro-financial stability perspective, would indicate that the United Kingdom is more vulnerable than some other advanced countries.⁹ In reality, the United Kingdom serves as a global financial centre; many foreign banks are established in the United Kingdom. As a result,

⁹ FDI represents a lasting interest in an entity and FDI flows are generally less volatile than portfolio flows. Therefore, FDI is not as likely to experience the sudden reversals that short-term portfolios have exhibited in certain situations such as in the South East Asian countries in 1997/98.

many capital flows into the United Kingdom do not represent foreign investment in the United Kingdom *per se*, but investment into various European firms. The result is that the recorded share of direct investment is lower than it would otherwise be. Because of the large volume of capital flows into and out of the country, the United Kingdom has a very large stock of gross foreign liabilities relative to GDP, compared to other countries.¹⁰ Therefore, FDI relative to gross domestic product gives a better indication of the degree of foreign ownership of firms.

Figure 2
Share of foreign direct investment, 2000



Source: IMF, Datastream

Returns to investment

Table 1 showed that New Zealand has been running a current account deficit over recent years (and indeed, for most of New Zealand's history) and has a negative net international investment position. A large part of the current account deficit can be attributed to the balance on income. As New Zealand is a net debtor, it is not surprising that the income balance is negative. However, an important question is how the returns to New Zealand investment abroad compare with returns to foreigners investing in New Zealand.

Table 2 shows that overall returns to New Zealand investment abroad have been significantly lower than returns to foreign investors in New Zealand over most of the 1990s. Generally these numbers reflect the fact that New Zealand investment

¹⁰ This can be seen in figure 2 by comparing the difference in the two columns for the United Kingdom. If total liabilities were equal to GDP, the columns would be of equal height. Because gross liabilities are three times GDP, FDI to liabilities is much lower than FDI to GDP.

Table 2
Returns to investment (annual returns (%))

	New Zealand investment abroad	Foreign investment in New Zealand
1993	3.9	5.3
1994	2.7	7.9
1995	5.8	7.9
1996	1.6	7.1
1997	1.7	6.7
1998	4.6	5.1
1999	4.3	6.0
2000	2.4	5.9
2001	1.4	5.4
2002	2.4	5.0

Source: IMF, Statistics New Zealand, and RBNZ calculations

abroad has not been as profitable as foreign investment in New Zealand. A significant proportion of net foreign financing takes the form of debt and, of course, interest rates in New Zealand have generally been higher than interest rates abroad. However, there are measurement issues that can also affect the comparability of these numbers. As an example, consider the returns to portfolio equity investment. Dividend income is the only type of income reported in the equity portion of portfolio investment income,¹¹ so differences in dividend payouts across countries may explain the return differential to some extent.¹²

As at March 2002, 38 per cent of New Zealand's portfolio investment abroad was into the United States, 14 per cent

was to the United Kingdom, and 13 per cent was to Australia. To give some perspective on relative dividend payout rates, the second column of table 3 shows the percentage of firms in the associated index that pay dividends. The third and fourth columns show the 12-month average and median dividend yield of those firms that pay dividends. Columns five and six show the 12-month average and median dividend yields of all firms in the index.

New Zealand firms tend to have, on average, a higher dividend yield than do their foreign counterparts. A caveat, however, is that 2001 was a difficult year for corporates in North America and Europe and will be reflected in lower dividend payouts to some extent. Differences in tax policies

Table 3
Dividend payouts – as at June 2002

(1)	Share (2)	12 month avg yield (3)	12 month median yield (4)	12 month avg yield* (5)	12 month median yield* (6)
NZSE40	82.6	5.4	5.4	4.4	4.4
AORD30	67.0	5.6	5.2	3.8	3.5
S&P500	71.4	1.9	1.6	1.4	1.0
Bloomberg Euro 500	86.0	2.8	2.5	2.4	2.3

* all companies

Source: Bloomberg and RBNZ calculations

¹¹ See Barrow and Bray (2001) for a detailed discussion on this issue.

¹² Both dividend income and retained earnings are recorded in the current account under "income from foreign direct investment" reflecting the fact that having a degree of ownership control allows the investor to influence dividend policy.

might explain why New Zealand entities are willing to invest abroad in firms with low dividend yields and why New Zealand firms might have a higher dividend payout rate. New Zealand does not double tax dividends, so the tax incentive to avoid issuing dividends is not present for firms. New Zealand does not generally tax capital gains but does tax dividend income so New Zealand entities might seek to invest in equities that do not pay dividends but realise large capital gains, in order to lower tax bills.

Because capital gains are not included in income, total returns (dividends plus capital gains) will not be fully reflected in the current account.¹³ Portfolio equity investment represents approximately 20 per cent of the stock of New Zealand assets abroad and is the largest single category after foreign direct investment, so this accounting issue could significantly impact the measured current account deficit during years when capital gains are large. A rough calculation¹⁴ shows that, on average over the 1997-1999 period, if capital gains were included in portfolio equity investment income, the current account deficit would have declined by just over 1 per cent of GDP each year. Of course, this was a period of large gains in overseas equity markets, and this issue could work in reverse in the current period of equity market declines around the world. It is important to stress that international investment position statistics are not susceptible to the measurement problem associated with capital gains or losses because they take into account revaluations.

Debt to related entities

Foreign ownership of firms in New Zealand, as well as other short and long-term borrowing, contributes significantly to New Zealand's external debt. Table 4 shows the breakdown of external debt to parents, subsidiaries and external parties. Debt to non-resident related entities was almost \$49 billion as at March 2002. Total external debt as at March 2002 was \$132.5 billion, so that the debt due to related entities represented 37 per cent of total external debt. The banking sector accounts for a large part of this. As at December 2001, the five largest banks in New Zealand owed approximately \$21.5 billion to non-resident related entities, accounting for almost 44 per cent of New Zealand's debt to related entities.

Debt due to related entities could be considered "safer" than debt due to unrelated entities from a macro-financial stability perspective for two reasons. Firstly, debt due to related entities may really function as equity, as in the holding company example discussed earlier. Equity earnings are a residual claim and cannot be defaulted on. Secondly, should a subsidiary get into difficulties, the parent company will normally have an incentive to renegotiate debt payments, roll over debt contracts, and even provide new funds in order to help the subsidiary. It is plausible to assume that unrelated external parties, not having the same level of interest in the subsidiary, would not react in the same way. While, for the reasons noted above, debt to related entities is, on balance, 'safer', there is one way in which over-reliance on this source of funding can lead to potential vulnerability. If the parent

Table 4
Composition of external debt as at March 2002

	NZD millions	Share in total*
Debt to overseas investor (parent or owning enterprise)	25,425	19%
Debt to overseas investee (subsidiary)	23,500	18%
Debt to unrelated overseas entities	64,722	49%
Total for banks and other sectors	113,647	86%
Official sector	18,925	15%
Total overseas debt	132,572	

* Does not sum to 100 per cent because of rounding.

Source: Statistics New Zealand

¹³ This is not to argue that capital gains should be included as income, but rather to note that capital gains (or losses) are a source of earnings on equity investments.

¹⁴ Capital gains were calculated by subtracting portfolio equity flows from the change in the stock of portfolio equity investment in a given period. This method will fail to control for errors and omissions.

experiences a credit downgrade or other form of credit deterioration, the cost of capital to the subsidiary will be affected as well. If the subsidiary maintains diverse funding sources, then it will have a better chance of securing credit based on its own credit rating. Moreover, large amounts of related party debt tend to increase the risk of intra-group contagion, increasing the risk of a parent entity's failure causing the failure of the New Zealand operation.

The role of the banks

Each of New Zealand's five major banks is foreign-owned; four are wholly owned subsidiaries of foreign banks and the fifth is a New Zealand branch of a foreign bank.¹⁵ Foreign bank ownership affects both the financial account and the current account of the balance of payments as well as the international investment position. The purchase of the New Zealand entity by a foreign entity would be recorded in the financial account during the quarter in which it occurred, as an inflow under the foreign direct investment category. This would occur whether the banks were New Zealand owned or otherwise. If they were purchased from a foreign entity and the foreign entity repatriated the funds, a corresponding outflow would be recorded as well.

During subsequent periods, foreign ownership appears in the income portion of the current account as the New Zealand entity services the parent's investment. The income recorded in the current account includes both dividends and retained earnings, as discussed above. In addition, the international investment position statistics reflect foreign ownership in the stock of foreign direct investment in New Zealand. Purchases of New Zealand entities add to the stock of New Zealand's international liabilities and changes in the market value of the New Zealand entity will be reflected in a change in the value of international liabilities.

It is important to stress that in a country with developed markets, such as those in New Zealand, foreign bank ownership in itself does not necessarily cause an increase in overseas funding; to the extent that domestic savings (as a source of funding) fall short of domestic investment needs, overseas funding will occur. What will change is the way in

which the funding is arranged and recorded. If no adjustments were made in the balance of payments statistics, funding from parents would appear in the direct investment category, whereas if the banks were domestically owned – or received funding from sources other than the parent – the funding would appear in either portfolio or other investment. In order to account for this, prior to June 2000, Statistics New Zealand categorised long-term debt as direct investment and short-term debt as portfolio or other investment depending on the type of flow. A more sophisticated approach has been undertaken since June 2000, where Statistics New Zealand distinguishes between permanent debt and other debt when categorising flows as direct investment.¹⁶ Permanent debt is the funding undertaken to establish or purchase the operations of a subsidiary. Financial flows undertaken to augment a subsidiary's funding is categorised as "portfolio debt" or "other investment" in the financial account, regardless of whether the funding comes from a parent or an unrelated entity. The new classification is an improvement, as it more accurately captures the economic underpinnings of the respective flows.

5 Conclusion

This article provides an outline of how a number of corporate transactions affect the balance of payments. Corporate overseas borrowing and lending, and corporate financing decisions, affect the level and composition of capital flows. Because of the difficulties in classifying some types of transactions, and the divergence between legal or accounting classifications of transactions and their economic substance, balance of payments data do not always reflect the true economic situation. For example, gross capital flows can be inflated when a parent company borrows on behalf of an overseas subsidiary. Similarly, the composition of FDI can be misleading, with the share of debt overstated, when holding companies borrow from overseas parents. Measurement issues also affect the income balance of the current account. Capital gains are not included in portfolio income flows so,

¹⁵ See Hull (2002) for a detailed discussion of foreign bank ownership and financial stability.

¹⁶ This breakdown is not published, but it is a conceptual change in how the balance of payments statistics are calculated.

for example, if a significant share of portfolio income derived from offshore comes from capital gains, income from abroad will be understated. These factors vary by country and change over time. Therefore, interpretation of these statistics in a macro-financial stability context requires caution and a sound understanding of institutional detail.

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Speech

The evolution of monetary policy in New Zealand: a speech to the Rotary Club of Wellington

Dr Alan Bollard, Governor, Reserve Bank of New Zealand, 25 November 2002

As a new central bank governor, what I would like to do first is to give you an overall perspective on the role of the Reserve Bank in the New Zealand economy. I will then focus in on the role of monetary policy, and the implications of the new Policy Targets Agreement, and conclude by discussing how all this relates to achieving strong and sustained economic growth.

Monetary policy formulation is a key function of the Reserve Bank, and it is often in the news. But the public attention obscures the other important tasks that the Reserve Bank undertakes. In the hubbub, the fact that monetary policy is part of a larger picture is often lost. The *overall* purpose of the Bank, as I see it, is to maintain the stability and efficiency of the New Zealand financial system.

By the financial system, I mean the tools with which New Zealanders make transactions with each other and with the rest of the world. For very simple transactions, New Zealanders use notes and coins issued by the Reserve Bank. As you may know, nowadays our bank notes are made out of a polymer material that lasts much longer than in the days of paper money. This reduces the Reserve Bank's costs. A side effect is that you'll be seeing Dr Brash's signature around the place for a while yet. Polymer notes are also very difficult to forge, because of their modern security features. That relates to our goal of an efficient financial system. A banknote that is easy to forge would make transactions difficult. Imagine having to check every twenty dollar note that came out of an EFTPOS machine.

Of course, nowadays most significant payments are made using electronic means of transferring funds provided by the financial system. These are much cheaper, faster, and more secure than using large volumes of cash, particularly over long distances. The financial system also facilitates transactions that involve borrowing and lending. For example, individuals accumulate savings in our financial system, and invest those savings in assets like shares and term deposits. These funds then often find their way to New Zealand corporations and households, and are used to

build New Zealand's infrastructure. Typically, the individual investor receives a return on those investments, and is able later on to draw on the originally invested funds.

We often take this system for granted, yet its smooth operation is essential to the wellbeing of the New Zealand economy. Banks play a key role in directing funds from individuals who wish to save to individuals who wish to borrow. The system works because people have confidence that funds deposited in banks will be available to them in the future, and that those funds will retain their buying power through time. The Reserve Bank has a central role in providing the regulatory framework for institutions that wish to describe themselves as "banks". We register banks and we monitor their compliance with a comprehensive financial disclosure regime, required minimum capital adequacy ratios, and limits on the loans they can make to related parties. Our framework emphasises the role of bank directors in ensuring that banks effectively manage their risks, and on the role of the market in strengthening incentives for prudent management. This helps to promote a sound banking system.

However, no banking system is without risk. Depositors still need to make their decisions carefully. Banks in New Zealand are not guaranteed by the Government or the Reserve Bank. There is no mandatory deposit insurance in New Zealand.

I mentioned that an efficient financial system needs to have mechanisms by which money can be stored. This is so people can access their money when they need it, without their savings having eroded in value. Ensuring that money holds its value is the primary purpose of monetary policy. Indeed, by statute the Governor of the Reserve Bank is required to use monetary policy to keep the buying power of the New Zealand dollar broadly stable over time.

Maintaining price stability does not mean keeping the price of each and every item the same. I am charged to maintain a stable *overall* level of prices, but individual prices are always changing. Some things, like computers, will probably

continue to get cheaper, while some other things may continue to get more expensive, like Martinborough Pinot Noir. But the overall buying power of people's savings is intended to remain broadly constant over time. In the current Policy Targets Agreement, I am specifically directed to attempt to achieve trend inflation outcomes between 1 and 3 percent.

Why is this the primary objective of monetary policy? Both economic theory and hard experience suggests that money holding its value over time helps an economy achieving its potential. Stable money is not a silver bullet, and on its own it can achieve little. However, stable money is one of the building blocks of a successful economy.

Yes, I could use monetary policy to engineer temporary economic growth. By lowering interest rates I could encourage people to borrow and spend for a period. As firms saw increased demand for their products, they would seek to expand output to meet that demand. They would invest in new capital and hire more workers, and this would create even more demand in the economy.

At first this would look like a virtuous circle, one which could lead to an extended period of economic growth. The problem is that lowering interest rates for a period can not create out of thin air the resources needed for growth. Firms that tried to employ more labour and buy more capital goods would quickly run into shortages. That would lead to cost increases for them, and also lead them to put prices up themselves. Eventually, rising costs would make people realise that their increased activity was not profitable. Then the boom would turn into a bust, and firms would be forced to retrench.

Moreover, during the boom period, inflation would rise beyond the price stability target, and the perverse incentives that inflation causes in investment and planning decisions would begin to weaken the economy. To be sure, if I allowed inflation to climb to just 4 or 5 per cent, the effect would be more subtle than the damage done when we had much higher inflation back in the 1970s and 1980s. But 4 to 5 per cent inflation would add nothing to New Zealand's enduring growth rate and it might well trigger a larger inflation problem later on. So I have committed to deliver a trend rate of inflation consistent with the 1 to 3 percent range in the new Policy Targets Agreement. In other words, I plan to

deliver a similar inflation rate to the one New Zealand has seen over the last decade.

But it is also important to make clear that monetary policy in the 21st century involves more than just fighting inflation. I've described our over-arching goal as maintaining the stability and efficiency of the New Zealand financial system. Thus, the Reserve Bank cannot afford to be, in the words of Bank of England Governor Eddie George, "inflation nutters". We are not permitted to cure the patient by killing it.

Let me explain how flexible monetary policy avoids such a result. By its nature, the New Zealand economy is often hit by economic disturbances – for example, changing conditions in the world economy, El Nino and La Nina periods in the weather and fluctuations in the number of people moving to and from New Zealand. All these things can have major impacts on the New Zealand business cycle. They frequently also have consequences for the inflation rate, which are sometimes temporary in nature. One example likely to have only a temporary effect is a drought, which in the short term typically pushes up the prices of agricultural products like fruit and vegetables, generating inflation. However, increases in the prices of things like fresh fruit and vegetables generally would not be seen by the public as the start of a general inflation problem. So it is unlikely that the inflationary consequences of this sort of disturbance would be long lasting. That is particularly true because overall spending in the economy would be reduced by a drought, because farm incomes would be down. So if monetary policy is excessively focused on price stability and we attempt to stop inflation caused by temporary climatic shocks, we could end up exacerbating a recession. By contrast, a policy which looks through short-term inflation fluctuations is much less disruptive to the real economy, and, of course, that's what we do.

In addition, the challenges that central banks face change over time. Look at other developed countries over the past decade or so. Having successfully eliminated the inflation problems of the 1970s and 1980s, central banks could be forgiven for expecting the late 1990s and this decade to be an easy ride. In reality, many central banks face arguably greater challenges. For example, in Japan, despite interest rates falling to very near zero, weakness in private sector demand has persisted for the best part of a decade.

Monetary policy in Japan has been unable to prevent deflation - that is, persistent falls in the overall level of prices.

In the United States, the challenge has been running monetary policy in a period where many people believed the economy was moving through a technological revolution that would lead to a prolonged inflation-free, economic boom. That belief translated into very high asset prices, which helped to underpin a long period of strong consumption and investment spending. A key question policy makers faced was whether the asset prices represented fair value, or were a bubble that reflected a collective over-optimism about the future.

Finally, many central banks, including New Zealand, have struggled with the consequences of volatile nominal exchange rates. For example, both the Norwegian and British currencies have persisted at high levels which have been very tough for their exporters. There has been little scope for monetary policy in those countries to solve this problem without generating inflation that would be equally damaging to their exporters.

In my view New Zealand is not about to undergo any of these scenarios. But the world that we face now has moved on from the world of 1989, when the Reserve Bank Act was passed into law. Maintaining price stability, as I am required to do, is different from firstly having to achieve it, as was required then. As you know, before becoming Governor, I signed a new Policy Targets Agreement with the Minister of Finance. This new agreement offers monetary policy a bit more scope to take evolving circumstances into account. In particular, the new agreement makes clearer that the Reserve Bank should maintain price stability in a flexible way that does not unnecessarily disrupt the real economy.

The key change in the agreement is that the inflation target has been explicitly defined in terms of "future inflation ... on average over the medium term". This implies that monetary policy should be forward-looking, and avoid getting distracted by transitory fluctuations in the inflation rate. In typical circumstances, we expect to give most attention to the outlook for CPI inflation over the next three or so years. If the outlook for trend inflation over that period is inconsistent with the target, we will adjust the Official Cash Rate. Our intention will be that projected inflation will

be comfortably within the target range in the latter half of the three year period. This means we will set policy so that inflation will be within the target range in the medium term, unless we are hit by a major surprise event. If a major surprise does occur, we will explain what has caused inflation to be higher or lower than we wanted, and what steps we will take to ensure that it goes back comfortably within the band.

I said the new Policy Targets Agreement offers us a little more flexibility, but it's a flexibility that needs to be applied with care. The language of the new agreement makes clear that inflation should not be *persistently* outside either end of the band. This is because a sustained breach of the target could affect people's perceptions of the trend inflation rate. That in itself could create a major inflationary problem. Thus, if one of the disturbances I mentioned earlier appeared to be strongly stimulating or weakening activity in New Zealand – suppose there was a sharp and persistent increase in tourist numbers for example – then the inflationary consequences might not be transitory. So, to keep inflation from rising and activity from going through a boom-bust cycle, monetary policy still needs to act to counteract the impact of these disturbances. And monetary policy still needs to respond particularly assertively when inflation is expected to be well outside the target range, or persistently outside it. But, at other times, if inflation is fairly stable and if we do not see pressures that have the potential to get out of control, then we have a mandate to be a little more flexible in our response.

Is this increased flexibility justified? In other words, can we be a little more flexible than in the past without taking risks with price stability? I think we can, because keeping prices stable gets easier when prices have already been stable over an extended period. If inflation suddenly rises just after a period, like in the 1980s, when it was out of control, then there is a risk it will spark a self-fulfilling belief that it is out of control once again. In other words, if people believe that inflation is out of the bag, they may translate that into higher prices for the goods and services that they sell and higher demands for increased salaries and wages.

By contrast, after inflation has been low and stable for a long time, people are much less likely to see price fluctuations as the start of something serious. Then a self-fulfilling prophecy is much less likely. Our freedom to be more flexible without compromising our price stability goal is thus a

consequence of the hard-won achievement, during my predecessor's tenure, of an environment where prices are *expected* to be broadly stable over time. In operating monetary policy, we will continue to carefully monitor people's perceptions of the inflation outlook, to confirm that their confidence in price stability remains strong.

What then of New Zealand's current economic situation? As you know, the New Zealand economy has been going through a strong period, stimulated by international conditions favourable for us. We have had record tourist numbers, and excellent returns on dairy products and many other agricultural commodities. We've also had a very quick turnaround from a net outflow of migrants a year or so ago to a very strong net inflow, which has more than doubled New Zealand's population growth. In combination, these factors have led to pressure on New Zealand's resources. For example, many firms have seen strong demand for their products. This particularly applies to firms in sectors like retailing and construction that supply New Zealand households. When they've tried to expand to meet that demand, employers have reported difficulty finding additional staff.

This tends to create pressure on prices, and indeed, at present, inflation is near our price stability ceiling. But we run policy looking forward, and it has not been clear how long the effects of that offshore stimulus will last. In the United States the long expansion has given way to recession, and the recovery from that recession appears to have faltered. The Australian economy is experiencing the effects of a drought and, like us, deteriorating trading conditions offshore.

Moreover, the New Zealand dollar has been rising off the low levels seen a year or so ago. For these reasons, over the next couple of years we expect economic growth in New Zealand to slow from its present high rate. We expect that this will constrain much of the inflationary pressure that we see now in some sectors of the economy. At the same time, the rising dollar means that New Zealand dollar prices of imports have fallen. As a result, we expect New Zealand's overall inflation rate to slow quite quickly over the next year.

In terms of monetary policy, in this situation I see good grounds for waiting and seeing how things evolve. Interest rates are at a level in New Zealand where, in our view, they

are not significantly stimulating or restraining the economy. If the world economy picks up and the New Zealand expansion continues, we will probably need more contractionary policy settings during 2003. On the other hand, further deterioration offshore and signs that it is catching up with New Zealand could require stimulatory monetary policy settings. So we are keeping our options open.

Finally, let's go back to the broader context for the Reserve Bank's task. I have described how the Bank is focused on helping deliver a stable and efficient financial system to the New Zealand public, and how low and stable inflation is an important part of that. I have suggested that doing this contributes to sustainable and balanced economic development. I've also said that price stability is a contribution but not a solution to the economic challenge facing New Zealand.

How do I see this challenge? Recall that New Zealand's standard of living, as measured by GDP per capita, barely improved at all between 1975 and the early 1990s. It is only in the last decade or so that the New Zealand economy has managed to achieve a sustained lift in growth. The projections I released last week suggest that this growth will continue, but not at a pace sufficient to close the gap that has developed between our GDP per capita and the OECD average.

To do that, over the next 20 years our rate of growth in GDP per capita would have to rise from 2.2 per cent over the last decade to almost 3 per cent over the following twenty years. That's presuming the rest of the OECD grows at the same rate as in the last decade. Achieving this sort of productivity improvement is a worthy challenge. It is only by meeting that challenge that we will get more of the things we need: greater after tax income, improving standards of health care, education, and environmental protection, and faster and faster boats to keep defending the America's Cup.

I hope I have made clear today that the Reserve Bank will be working to achieve continued price stability without standing in the way of sustainable economic growth. Indeed, I think sound, flexible monetary policy contributes to the strong, balanced economic growth that, we all agree, New Zealand needs.

RESERVE BANK DISCUSSION PAPERS

This section sets out the abstracts of recently issued Reserve Bank Discussion Papers. The Discussion Papers are available on the Reserve Bank web site and can be obtained in hard copy on request from the Reserve Bank.

DP2002/01

Extracting expectation of New Zealand's Official Cash Rate from the bank-risk yield curve

By Leo Krippner, March 2002, (PDF 412KB)

The hypothesis that a forward term-premium (FTP) exists between forward 1-day rates calculated from the New Zealand bank-risk yield curve and the corresponding ex-post Official Cash Rate (OCR) is tested by applying a single equation method for a cointegrated system to daily data from March 1999 to December 2001. The results indicate that the FTP is statistically significant for all forward horizons tested. The results also indicate that the estimates of the FTP appear to be an increasing function of the forward horizon, and the FTP may be tentatively represented as a simple monotonically-increasing analytical function. The model may be used in reverse to imply current ex-ante expectations of the OCR.

DP2002/02

Modelling the long-run real effective exchange rate of the New Zealand Dollar

By Ronald MacDonald, October 2001, (PDF 373KB)

The usefulness of the concept of an equilibrium exchange rate has been brought into sharp focus by the dramatic depreciation of the euro since its inception in 1999. Does this movement reflect a movement of the actual exchange rate relative to its equilibrium or has the equilibrium shifted relative to the perception of where the euro was in 1999? Similar kinds of questions have been asked about the behaviour of the New Zealand dollar since the latter part of 1999. To answer these kinds of questions it is necessary to have some measure of an equilibrium exchange rate and there are a plethora of alternative approaches available in the literature. In this paper we use the behavioural equilibrium exchange rate (BEER) approach of Clark and MacDonald

(1999) to produce long-run equilibrium exchange rates for the effective real exchange rates of the New Zealand dollar. We demonstrate that a well founded measure of the equilibrium value of the dollar may be recovered from a relatively small set of fundamental variables and that this can be used to produce an assessment of the dollar in terms of periods of misalignment.

DP2002/03

Monetary policy and inflation forecasting with and without the output gap

By Weshah Razzak, March 2002, (PDF 1078KB)

Some observers have worried that under or over-estimating the output gap may unnecessarily induce tightening or loosening of monetary conditions, causing real fluctuations. To investigate the relationship between the output gap and inflation, we examine models of inflation that do and do not use the output gap. The Phillips curve, which relates inflation to real activity, is regarded as the maintained theory of inflation. Models of inflation without the output gap include the equation of exchange of the quantity theory of money, the real interest rate gap, and two versions of the model. Since none of these economic models are either totally wrong nor complete, it makes sense to diversify across models rather than relying on one model exclusively. The forecasts derived from different stable models can be combined through averaging, which offsets biases and reduces the forecast error variance. Such model diversification spreads the risks of errors (i.e., insurance about bad outcomes that arise from the reliance on a single model) and provides greater robustness for policy. This paper examines ten different models of inflation and estimates sixty-seven different specifications, some of which outperform others. Some explanatory variables like money and the real interest rate gap seem to provide more information about future inflation than does estimates of output gap.

DP2002/04

Extracting market expectations from option prices: an application to over-the-counter New Zealand dollar options

By Aron Gereben, April 2002, (PDF 314KB)

What are the odds of a large shift in the exchange rate? Is a large depreciation more likely than a large appreciation? This paper uses over-the-counter New Zealand dollar/US dollar option prices to quantify market expectations of exchange rate uncertainty through measures based on risk-neutral probability distribution functions. Results suggest that the estimated probability distributions can provide important insights into market perceptions about exchange rate risk in the future. Econometric evidence indicates that the higher moments calculated from risk-neutral probability density functions can be used to explain the dynamic behaviour of the forward bias measured in the New Zealand dollar/US dollar exchange rate.

DP2002/05

Foreign-owned banks: Implication for New Zealand's financial stability

By Leslie Hull, April 2002, (PDF 217KB)

Of the five major banks in New Zealand three are owned by Australian parent companies, one operates as the New Zealand branch of an Australian bank, and one has a British parent. Thus, bank ownership in New Zealand is foreign, but not very diversified. The literature on foreign bank ownership predominately focuses on developing countries and highlights the fact that large, diversified banks can enhance stability. New Zealand differs from the developing countries previously studied, as it is a developed country with foreign, but not necessarily diversified ownership. This paper explores the composition of bank ownership in New Zealand and the implications for financial stability. The paper begins with an analysis of the diversification of parent companies' assets and discusses the implications of institutional arrangements between parents and their subsidiaries for financial stability. Next, the degree of interdependence between Australia and New Zealand is analysed. Finally, the paper presents stylised implications of the structure of the

market on bank behaviour during a time of crisis. The interaction of these three factors dictates the implications of foreign bank ownership on financial stability in New Zealand.

DP2002/06

Estimating a Taylor Rule for New Zealand with a time-varying neutral real rate

By L Christopher Plantier and Dean Scrimgeour, May 2002, (PDF 462KB)

Many critics of the Taylor rule claim that it is inferior to inflation forecast based (IFB) rules because it is not forward-looking, is not aggressive enough, and because of uncertainty surrounding the output gap. Nevertheless, the Taylor rule serves a constructive purpose because it abstracts from the Bank's macroeconomic model, FPS, and its performance is robust across various economic models. The Taylor rule thus provides a useful cross-check to the IFB rule, whose recommendations necessarily rely on a particular model structure, its dynamics and specific judgements over the forecast horizon. Additionally, this paper contends that any interest rate rule or model must account for the fall in the ex-ante real interest rate and the non-stationarity of short-term rates in New Zealand. We show how the neutral real interest rate (NRR) in the Taylor rule drifts downward since the second quarter of 1988, and explain why this presents additional real-time difficulties for the Taylor rule.

For the record: recent press releases

RBNZ: Austraclear merger not being considered

20 September 2002

The Reserve Bank today said that, despite a report in today's *Dominion Post*, it is not in discussions with any party regarding a merger or replacement of its Austraclear Depository System.

This comes after the *Dominion Post* reported that "The Stock Exchange is considering a merger of its settlement system with the Reserve Bank's Austraclear debt securities and equities settlement system."

Reserve Bank Acting Governor Rod Carr commented: "The Reserve Bank has not been in discussions with the Stock Exchange. It may be that the Stock Exchange is considering coming to the Bank with a proposal and if that is the case we will consider it. However, in the meantime the Reserve Bank remains committed to continuing to provide this service."

Austraclear is a wholesale operation for the clearing and settlement of high-value debt securities and equities. At 30 June 2002, Austraclear had 230 members with total investments of \$74.2 billion. The legal entity that Austraclear works within is a company, New Zealand Central Securities Depository Limited, which is wholly owned by the Reserve Bank.

OCR stable at 5.75 per cent

2 October 2002

The Reserve Bank today left the Official Cash Rate unchanged at 5.75 per cent.

Reserve Bank Governor Alan Bollard commented "The New Zealand economy has shown solid growth over the past year with both domestic and export activity proving robust. Growth over the June quarter of 2002 was a little stronger than we expected.

"However, growth among our trading partners has continued to track at relatively modest levels. This was anticipated to

some extent in the Bank's August *Monetary Policy Statement*, but recent developments in financial markets suggest that any sustained recovery offshore could take longer to occur than previously thought. The soft international backdrop is expected to dampen New Zealand's growth outlook over the coming year.

"Reflecting the balance of these factors, the overall outlook has evolved broadly in line with expectations. Inflation still appears likely to edge downwards over the next year or so. The focus of monetary policy is now on keeping inflation securely within the range mandated in the Policy Targets Agreement on average over the medium term. Given this, the Bank sees no urgency to adjust interest rates at this time. This should assist in ensuring that we also avoid unnecessary instability in output, interest rates and the exchange rate and that economic growth prospects are maximised, given our current outlook, Dr Bollard concluded.

The next OCR announcement comes with the release of the *Monetary Policy Statement* on 20 November 2002.

OCR unchanged

20 November 2002

The Reserve Bank has decided to leave the Official Cash Rate unchanged at 5.75 per cent. In addition, the Bank's projections show no change in short-term interest rates over the period ahead - reflecting the Bank's sense that the risks for the future direction of the OCR are evenly balanced.

Speaking at the release of the Reserve Bank's *Monetary Policy Statement* Reserve Bank Governor Alan Bollard said "The new Policy Targets Agreement directs the Bank to target future CPI inflation outcomes of 1 to 3 per cent on average over the medium term. Looking ahead, current policy settings appear consistent with that objective. In essence, strong domestic demand is expected to be offset by offshore developments, keeping inflation pressures in check.

"Unlike most trading partners, the New Zealand economy has performed well in 2002. Activity has continued to benefit

from the surge in export earnings over the past two years and from the recent rapid population growth. To date, weak global conditions have not had as large an impact on the local economy as we might have expected.

“ Strong activity has left businesses with limited scope to meet increases in demand without incurring extra costs and firms have been reporting ongoing difficulties in finding skilled and unskilled labour. These pressures are contributing to higher prices in some domestic-based industries, such as services.

“ However, the soft international economy, falls in some commodity prices and the path of the exchange rate have produced a fall in the inflation rate for tradable items. These offsetting factors have seen annual CPI inflation remain steady at a relatively high level.

“ Economic growth is likely to slow over the coming year, to a little below its average, reflecting international market

conditions and a moderating of the demand pressures associated with strong population growth. The rise in the exchange rate over recent months, if sustained, will also put downward pressure on inflation over the next few quarters and exert some braking effect on activity and inflation further out. From a starting point of some considerable pressure on resources, inflation pressures evident in some parts of the economy are likely to subside somewhat, although perhaps not immediately.

“ The new PTA provides monetary policy with a little more flexibility in the way it responds to changing economic conditions. Our intention is to operate policy in a flexible manner in order to meet our obligations under the PTA. We will continue to reassess economic developments and respond appropriately, Dr Bollard concluded.

Publications

Many Reserve Bank publications are available for download free of charge from the Reserve Bank website, www.rbnz.govt.nz

Publications - no charge

ANNUAL REPORT	Published in October of each year
MONETARY POLICY STATEMENT	Published quarterly. A statement from the Bank on the conduct of monetary policy. First copy free, subsequent copies \$12.00.

THE REAL STORY - SAVING AND INVESTING NOW THAT INFLATION IS UNDER CONTROL

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