
The Reserve Bank's role in the recent business cycle: actions and evolution

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The recent business cycle, spanning between the recession of the early 1990s and that in 1998, was the first full cycle experienced under the inflation-targeting regime formalised with the enactment of the Reserve Bank of New Zealand Act 1989. This article reviews how monetary policy evolved during that period and discusses some of the lessons the Bank has learned.

Some key conclusions are that:

- The strength of the upturn in the business cycle was underestimated and this required monetary policy to be held firmer for longer.
- A flexible approach to inflation targeting is appropriate, at least when the public is confident that medium-term price stability will be maintained. This approach explicitly recognises that less strict near-term control of inflation can result in less variability in financial market prices (interest and exchange rates), and in output.
- The Bank has been able to adopt a medium term approach, which:
 - places less emphasis on the direct effect of exchange rate changes on the prices of imported goods and services that appear in the CPI than was the case in the early to mid-1990s.
 - emphasises the importance of maintaining a monetary policy stance consistent with countering *persistent* sources of inflationary pressures, and places correspondingly less emphasis on any short-term, transitory, movements in consumer price inflation.

1 Introduction

In the December 1998 *Bulletin*, an article was published that reviewed the business cycle of the 1990s. The article discussed the various economic stresses and strains that impacted on the economy over the cycle. It covered issues such as what actually happened in the economy, which events were likely to prove one-off, and which events could be explained by theory, New Zealand's past experience, and international developments. What was not covered in that article, however, was the monetary policy dimension – other than what happened to monetary conditions and price pressures. This article focuses on the monetary policy issues,

including how policy has changed in the light of experience, and the thinking behind the changes.

The Reserve Bank's inflation-targeting framework has now been tested over a full business cycle. In general, New Zealand's inflation outcomes have been very good relative to our historical experience, and are now broadly in line with those of most other developed economies. The low and stable inflation of the 1990s is an excellent outcome given initial inertia in inflation expectations, and the robust growth and price pressures experienced over the period. Significantly, during the period under review, inflation targeting regimes similar to that adopted by New Zealand have been adopted by a number of other countries.²

It is useful to look back over the business cycle of the 1990s and ask what we have learned and how this will change monetary policy going forward. In answering this question,

¹ This article draws on work prepared by many people in the Bank's Economics Department over the last year or so. In particular, the authors would like to thank Anne-Marie Brook who co-ordinated the Department's effort in producing much of the background material. Bruce White and Michael Reddell have also contributed significant editing comments. We would also thank Leo Bonato, Paul Conway, Sharon McCaw, Alasdair Scott and Ben Hunt for their guidance. Tina Sutherland, Anna Kulhavy, Cheryl Ng and Caroline Campbell provided considerable statistical and technical assistance.

² Those countries include Australia, Canada, Finland, Israel, Spain, Sweden and the United Kingdom and most recently the European Central Bank.

we need to remind ourselves that the appropriate policy at any point in time depends on the surrounding economic circumstances, the tools available, and the subsequent economic developments. This leads to another important question: In what respects was policy in the 1990s responding to a specific set of circumstances, which may or may not be repeated?

This article addresses these questions and is structured as follows. Section 2 provides a “recap” of the business cycle and the inflation environment. Section 3 provides an overview of the key drivers of the business cycle and the extent to which these events were anticipated by the Reserve Bank. In Section 4, some key monetary policy questions are investigated using the Bank’s economic Forecasting and Policy System (FPS) model. We look at the impact of specific shocks on the economy during the cycle, at the Bank’s policy responses to those shocks, and at the potential trade-offs inherent in being more, or less, flexible in policy making. Section 5 briefly discusses aspects of the forecasting techniques and data issues. The final section concludes with a discussion of policy in the future.

2 The initial inflation environment and developments over the business cycle

The inflation environment going into the 1991-98 cycle

Although by the end of 1991 New Zealand’s inflation had been reduced to below 2 percent, from 16 percent in 1985³, this was against the backdrop of an extended history of high inflation – at least by the standards of most developed countries (see table 1). Thus, at the commencement of this business cycle, New Zealand had no recent track record of low inflation, let alone well anchored inflation expectations.

The Bank, therefore, began the recent business cycle still with the tasks of reducing inflation expectations and building public confidence in the inflation-targeting regime. It was not until well into the 1990s that inflation expectations became better anchored to the Bank’s inflation target range. This transition was hindered by the strong inflation pressures that developed in the mid-1990s.

Table 1: Inflation by decade in selected countries

Country	Average annual consumer price inflation over the periods:				
	1950-59	1960-69	1970-79	1980-89	1990-1995
<i>Countries which now have inflation targets:</i>					
Australia	6.5	2.4	9.8	8.4	3.3
Canada	2.4	2.5	7.4	6.5	2.7
Finland	6.2	5.1	10.4	7.3	2.7
New Zealand⁴	5.1	3.2	11.5	10.6	2.7
Spain	6.2	5.8	14.4	10.3	5.3
Sweden	4.5	3.8	8.6	7.9	5.0
United Kingdom	4.3	3.5	12.7	6.9	4.6
<i>G3 countries:</i>					
Germany	1.1	2.4	4.9	2.9	3.2
Japan	2.9	5.3	8.9	2.5	1.6
United States	2.1	2.3	7.1	5.5	3.5

Source King (1995), Statistics New Zealand for New Zealand data.

³ CPI inflation rose further to 19 percent in the 12 months to June 1987, but this included the effect of a comprehensive goods and services tax, which was introduced at a rate of 10 percent in October 1986.

⁴ CPI data for New Zealand are exclusive of credit service (including interest) charges, and exclusive of the effects on prices of the introduction (in 1986) and subsequent increase (in 1989) of the goods and services tax.

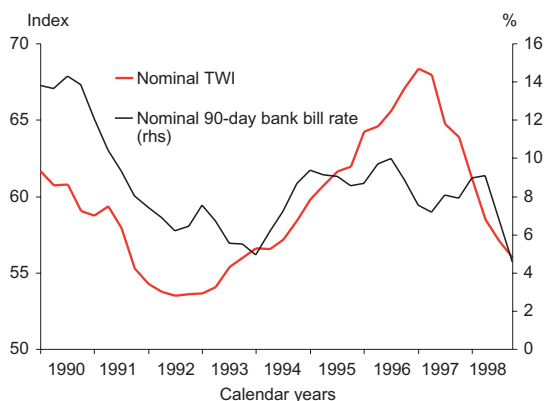
The business cycle in brief⁵

The economic recovery that commenced in 1991 turned out to be one of the strongest and most sustained for several decades. Initially, exports picked up strongly, assisted by a competitive exchange rate, a growing world economy, and rising commodity export prices. Despite a restrictive fiscal stance, the overall demand pressure was strong, with growth in business investment and private consumption, and a surge in immigration putting pressure on demand and the residential real estate market. Commencing about mid-1996, fiscal policy also eased by way of tax cuts and, later, increased government expenditure.

Monetary policy began to tighten in early 1994, and over that year short-term interest rates rose from under 5 percent to nearly 10 percent (see figure 1). In hindsight, however, it is questionable whether the tightening was soon and/or strong enough. By the end of 1994, the upswing in both the world and the New Zealand economy had been underway for over two years. Once underway, activity was sustained by a high level of confidence - indeed perhaps some exuberance - about the prospects for the economy. In addition, household wealth began to rise rapidly as real house price growth accelerated.

From being below the OECD average in 1992, real short-term interest rates had risen well above the OECD average by the second half of 1994, where they remained until as late as 1998. It was thus hardly surprising that the exchange rate appreciated significantly (see figure 1).

Figure 1: Nominal short-term interest rate and TWI exchange rate



⁵ This section draws heavily on Brook *et al* (1998), Orr *et al* (1998), and White (1998).

However, monetary policy may not have been the only factor ensuring the exchange rate performed strongly over that period. New Zealand's wider economic reforms received a lot of favourable attention internationally, and this also helped make New Zealand an attractive destination for international capital. It is difficult to know how large this exchange rate effect was in addition to the boost from tighter monetary policy. However, to the extent that there were additional capital inflows, a greater proportion of the monetary policy restraint occurred via the tradable (export and import competing) sectors of the economy, compared with the relatively more protected, interest rate-sensitive, domestic sector.

The downside of the economic cycle did not commence in earnest until late-1996. By then, evidence was emerging that inflationary pressures a year or so ahead were waning and that an easing in monetary policy could commence. However, it was not until the second quarter of 1997 that economic events ensured that the exchange rate fell. By July 1997, the outlook in Asia had become more doubtful, international investors became focused on a so-called 'flight to quality,' and New Zealand's current account deficit had increased considerably.

The exchange rate depreciated significantly between mid-1997 and mid-1998. During this period, however, upward pressure remained on short-term interest rates. In part this pressure reflected the implementation approach being used by the Bank at the time, and in part it reflected a judgement that monetary policy needed to be eased only gradually to moderate the rate of exchange rate depreciation and potential inflation pressures.

3 The drivers of the cycle and compounding economic shocks

This section elaborates on the specific events that influenced the economy and the Bank's policy actions during the cyclical upswing. The focus is the extent to which the timing and magnitude of events surprised the Bank when formulating monetary policy.

Structural developments

The upswing from recession in the early part of the 1991-98 business cycle was strongly influenced by the outcomes of past and ongoing structural developments. Some key structural changes included, for example:

- **trade liberalisation**, ie a marked reduction in tariffs and the end of import licensing;
- **capital account liberalisation**, ie the lifting of exchange rate controls and a host of other reforms which saw New Zealand become more open to international capital flows;
- **privatisation** of a number of government trading enterprises;
- **the deregulation of the domestic financial sector**, ie the elimination of restrictions on borrowing and lending interest rates, the removal of reserve requirements, and the opening up of the banking sector to foreign competition;
- **changes in the labour market**, eg the passage of the Employment Contracts Act (1991) designed to make wages and the labour market more flexible;
- **tax reform**, ie a broadening of the tax base, lower marginal income tax rates, and a shift in the balance between taxation of income and consumption, towards the latter;
- **fiscal consolidation**, which led to a large decline in the government's debt to GDP ratio, and less pressure on interest rates from this source.

Although many of these structural developments occurred in the 1980s, most of the benefits were realised during the sustained surge in growth in the early 1990s, and reinforced the strong cyclical factors noted earlier. Investment rebounded strongly, supported by both a better economic outlook and the end of a period of capital scrapping associated with the reform process. Consumer confidence also grew strongly, as employment prospects improved. With that came an increased appetite for debt, at just the time when credit became available increasingly readily. Banks had been recently deregulated and, following corporate lending problems experienced in the second half of the 1980s, were

actively targeting household lending. The upshot was an unexpectedly strong rise in household debt.

The Reserve Bank had to restrain inflation pressures driven not only by a strong appetite for consumption (in large part made possible by rising debt levels and wealth perceptions), but also strong investment. Furthermore, to the extent that the Bank's growth and inflation predictions were based primarily on current income flows, and did not allow for the increase in households' appetite for debt, there was an under-estimation of the strength and durability of domestic demand. Given this combination of events, the Bank was caught somewhat off-guard by the strength of demand in the early and mid-1990s.

Supply expansion

Following such a significant period of economic restructuring, the Bank was also struggling to measure the extent to which the economy's productive capacity had expanded. Potential output can be thought of as the level of activity the economy can sustain at a stable level of price inflation⁶. Estimates of New Zealand's potential output have been revised upward over the 1990s, as the result of a combination of increased labour supply and investment. However, assessing just how fast the supply capacity of the economy is expanding is difficult given that it can not be observed directly. Instead, various estimation techniques must be used to infer potential output.

Judging from the inflation pressures that emerged, it is likely that the official estimates of the potential output growth of the New Zealand economy may have been too high in the early 1990s. For instance, up to about 1995, and consistent with the views of most other commentators at the time, the Bank thought New Zealand's sustainable output growth had lifted to around 3.0 to 4.5 percent per annum. More recent estimates place it somewhere between 2.5 and 3.0 percent per annum.

Compounding shocks

The already mentioned surge in immigration, the sustained upswing in the world economy and, eventually, an expansionary fiscal stance, all contributed to the strength of

⁶ See Conway and Hunt (1997).

demand to a greater extent than was initially seen by the Bank.

After a net outflow of people over most of the 1970s and 1980s, net immigration turned strongly positive in the early 1990s. A large proportion of these long-term immigrants also had significant financial wealth, which led to upward pressure on asset, particularly house, prices and caused demand pressures to be stronger than the number of migrants alone initially suggested.

Fiscal policy also resumed an expansive role from 1996, with both tax cuts and increased government spending. In late 1995 the Bank responded positively to a request from the Minister of Finance for its view on whether tax cuts scheduled for mid-1996 could proceed without putting undue pressure on monetary policy. This assessment was made on the basis that the economy was already slowing under the influence of other factors, not least monetary policy. In hindsight, the strength of the inflation pressures proved to be underestimated. The tax cuts and resulting rise in spending pressure further prolonged the period of restrictive monetary policy.

In summary, a lengthy period of firm monetary restraint was required to contain the inflation pressures generated by the upswing in the economy that commenced in 1991. This inflation pressure was sustained by a succession of positive demand shocks that occurred as the cycle progressed. In the end, monetary policy had to remain firm through to the end of 1996.

At the end of 1996, the inflation target was widened from 0 to 2 percent to 0 to 3 per cent. Demand pressures were also easing and the stance of monetary policy began to be relaxed. Soon after, in the second part of 1997, the East Asian crisis broke. The summer drought of 1997/98 also saw agricultural output fall. Both events were sudden and severe enough to ensure that an expected "soft landing" turned into a "hard landing", as reflected in the recession in the first half of 1998.

Although the Bank identified both the 1997/98 drought and East Asian crisis early on, their full negative impact on the economy was not immediately appreciated.⁷ In any event, given the lags involved in monetary policy and the sudden-

ness of these developments, it was already too late to avoid most of the eventual decline in activity.

In sum, and in hindsight, 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. In the end, economic growth peaked at over 7 percent in 1994, which made the containment of inflation difficult and prolonged the time that a restrictive stance of monetary policy was required. This meant that the negative shocks from Asia and the drought, both of which turned out to be more severe than initially anticipated, came hard on the heels of a prolonged period of monetary restraint.

What this period strongly illustrates is the uncertainty that monetary policy must cope with. Unexpected events and changing behaviour will always ensure policy-making is difficult. As such, a robust framework is needed to manage the uncertainties. It is this we now turn to.

4 The Bank's policy framework over the recent business cycle

The discussion so far suggests a number of issues for closer examination. They fall into the following broad areas for analysis:

- what lessons can be drawn from the economic surprises that occurred and the way monetary policy responded? In particular, the focus is on issues of timing, such as how quickly were economic shocks identified and over what time horizon was monetary policy attempting to contain the ensuing inflation pressures?
- how forcefully should monetary policy respond to surprises and, the related question, how wide does the inflation target band need to be to reasonably accommodate most shocks?

⁷ The Bank incorporated into the December 1997 *Monetary Policy Statement* a 'pessimistic subset' of world *Consensus* forecasts, to reflect its view on the developments in East Asia. This resulted in the Bank making more allowance for the Asian crisis than many other commentators at the time. But, in the event, the crisis still proved to be worse than these pessimistic outlooks.

As one way of addressing these questions, we have used the Bank's macroeconomic model, FPS⁸. The following sections report on experiments that have been undertaken using two quite different types of model simulation techniques. First, we have performed "deterministic" simulations, in which the model is "shocked" in a way that replicates the single disturbance we are interested in, and simulated on the basis that all other relationships remain the same. From these simulations we can trace out how, according to the model, the economy responds under alternative policy reaction scenarios.

The second set of model experiments discussed is based on what are known as "stochastic" simulations. In this case, the model is subjected to a battery of shocks representative of those that a "real world" economy is continually being subjected to. Rarely, if ever, do "all other things remain equal" and certainly not over an extended period of time. Stochastic simulations, therefore, are designed to help us assess how alternative policy responses perform under the generality of shocks that occur in an economy.

It must be stressed that these simulations are illustrative experiments only. They do not tell us with **precision** how monetary policy should have been run in the past, or should be run in the future. Nonetheless, the results, together with our own insights and experience, provide intuitively plausible general insights into the way in which monetary policy might best be run.

Single disturbance experiments

Three sets of experiments were undertaken to investigate:

- What if the Bank had better anticipated the increased willingness of households to take on debt to increase spending?
- How much of an impact might an appreciation of the exchange rate, independent of interest rate effects, have had on the mix of monetary conditions and the external imbalance, and what was the appropriate monetary policy response?

⁸ See Black *et al* (1997) for a complete description of the properties of the FPS core model, and Drew and Hunt (1998b) for a discussion on how the FPS is used to prepare economic projections.

- In calibrating policy responses, how much difference does it make whether the policy horizon is short or longer?

Each of these questions is addressed in turn.

Household debt and the consumption shock

As already discussed, it is likely that the Bank's inflation projections over the early 1990s did not adequately incorporate the impact on demand of households anticipating *future* income growth. The Bank's forecasting model, FPS, can be used to examine the implications of underestimating demand pressures from this source.⁹ In the experiment a positive demand "shock", of around one percentage point per quarter for six quarters, is applied to the model.

Three alternative scenarios are explored (see figure 2).

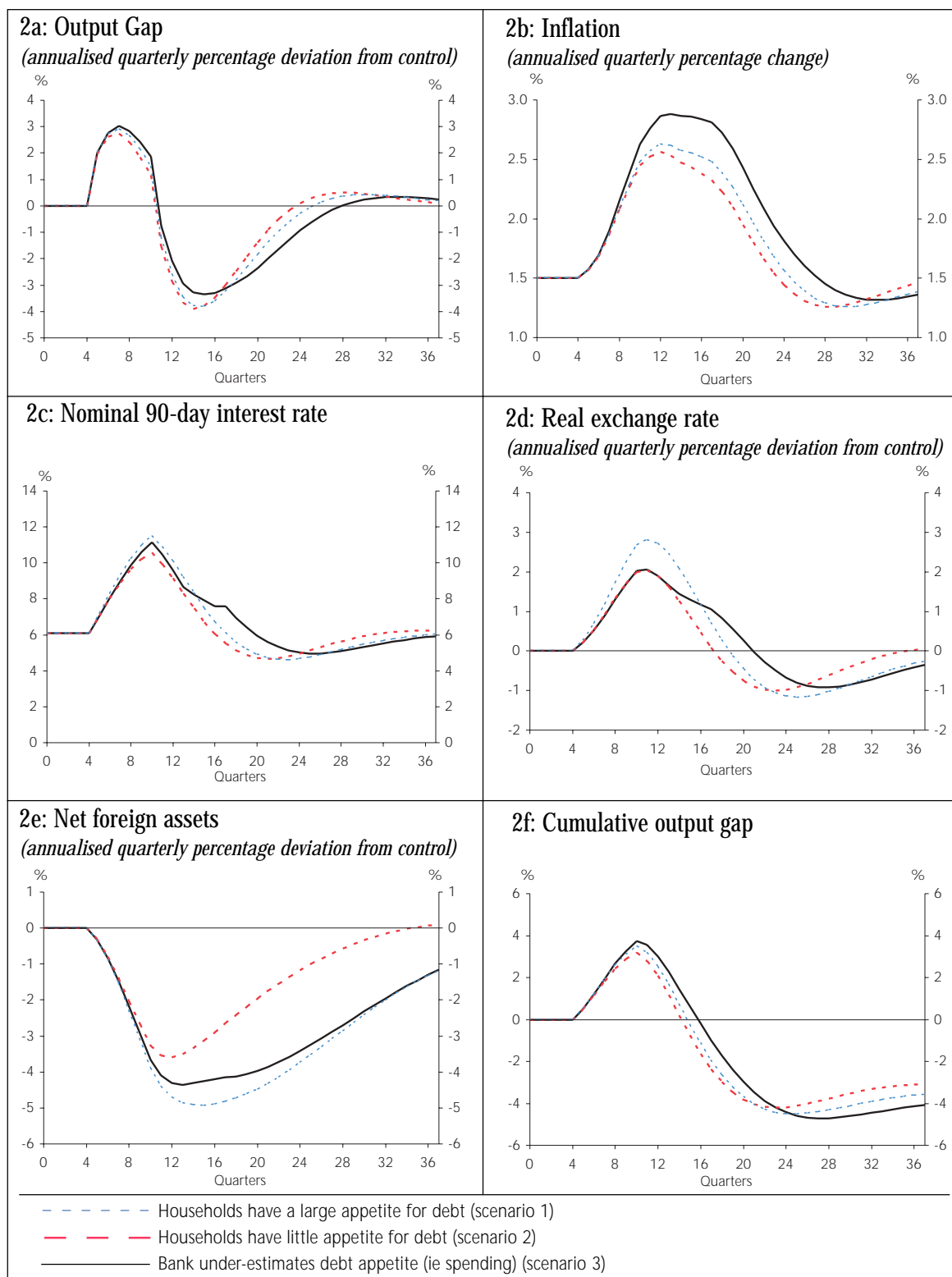
- 1 Households have a relatively **large** appetite for debt, in which case the shock is significantly accommodated by incurring extra debt.
- 2 Households have a relatively **small** appetite for debt and spending, ie, the economy is already "debt constrained" when the "shock" occurs.
- 3 Households have a relatively **large** appetite for debt, but the Bank sets policy assuming households have a **small** appetite. In other words, the Bank under-estimates the extent to which the shock can be accommodated by additional debt and thus underestimates the medium-term spending pressures in the economy.

In all three scenarios the unexpected increase in demand initially leads to an increase in inflation pressures (see figure 2B). The central bank responds to the inflation pressures by raising short-term interest rates, which also leads the exchange rate to appreciate (see figures 2c and 2d). The eventual slowdown in demand occurs via two paths. First, the rising interest rate favours saving over current consumption and hence reduces demand. Secondly, the exchange rate appreciation leads to a decline in the trade balance and

⁹ In FPS, trends in real disposable income and the level of net foreign liabilities largely determine household consumption patterns. By increasing households' appetite for debt, as reflected in the model by net foreign liabilities, they will consume more rather than save. Or, in other words, current consumption will be less constrained by current income.

Figure 2: The implications of underestimating demand

See the appendix for data definitions and a description of how the variables are calculated.



a rise in the net foreign liability position (depicted in figure 2e as a decrease in net foreign assets). Households respond to the rising debt levels by curtailing current consumption, most noticeably so in scenario 2 (the scenario in which households have a low appetite for debt).

The most interesting case, however, is where the Bank assumes households have a small appetite for debt, when in fact the opposite is true (scenario 3). This broadly corresponds to the unexpected increase in household debt that we saw in the 1991-98 business cycle. In this situation, the

Bank underestimates the inflation pressures (leading inflation to peak at around 0.5 percentage points higher, as seen in figure 2b) and does not respond as aggressively initially. The net result is that the Bank must eventually tighten policy for longer, prolonging the need for elevated real interest rates and an elevated real exchange rate (see solid lines in figures 2c and 2d).

The results broadly correspond with the way in which, through the cycle, interest rates in New Zealand held up above the OECD average for an extended period, and consequently account for some of the appreciation seen in the New Zealand dollar. The results suggest that if the initial policy response to rising demand had been earlier and/or more aggressive, the duration of the upward pressures on interest and exchange rates might have been significantly shorter.

Exchange rate shock

Over the recovery phase of the recent business cycle, the real exchange rate appreciated strongly. Most of this appreciation can be attributed to the rise in real interest rates needed to contain inflation. However, it is also possible that additional factors were temporarily supporting the exchange rate. As discussed earlier, these factors may have included the favourable marketing of New Zealand as an investment destination. Exceptionally low interest rates in Japan (and to a lesser extent Europe) may also have added to a strong demand for New Zealand dollar assets. Again, FPS can be used to mimic the impact of such a positive real exchange rate “shock” on the business cycle.

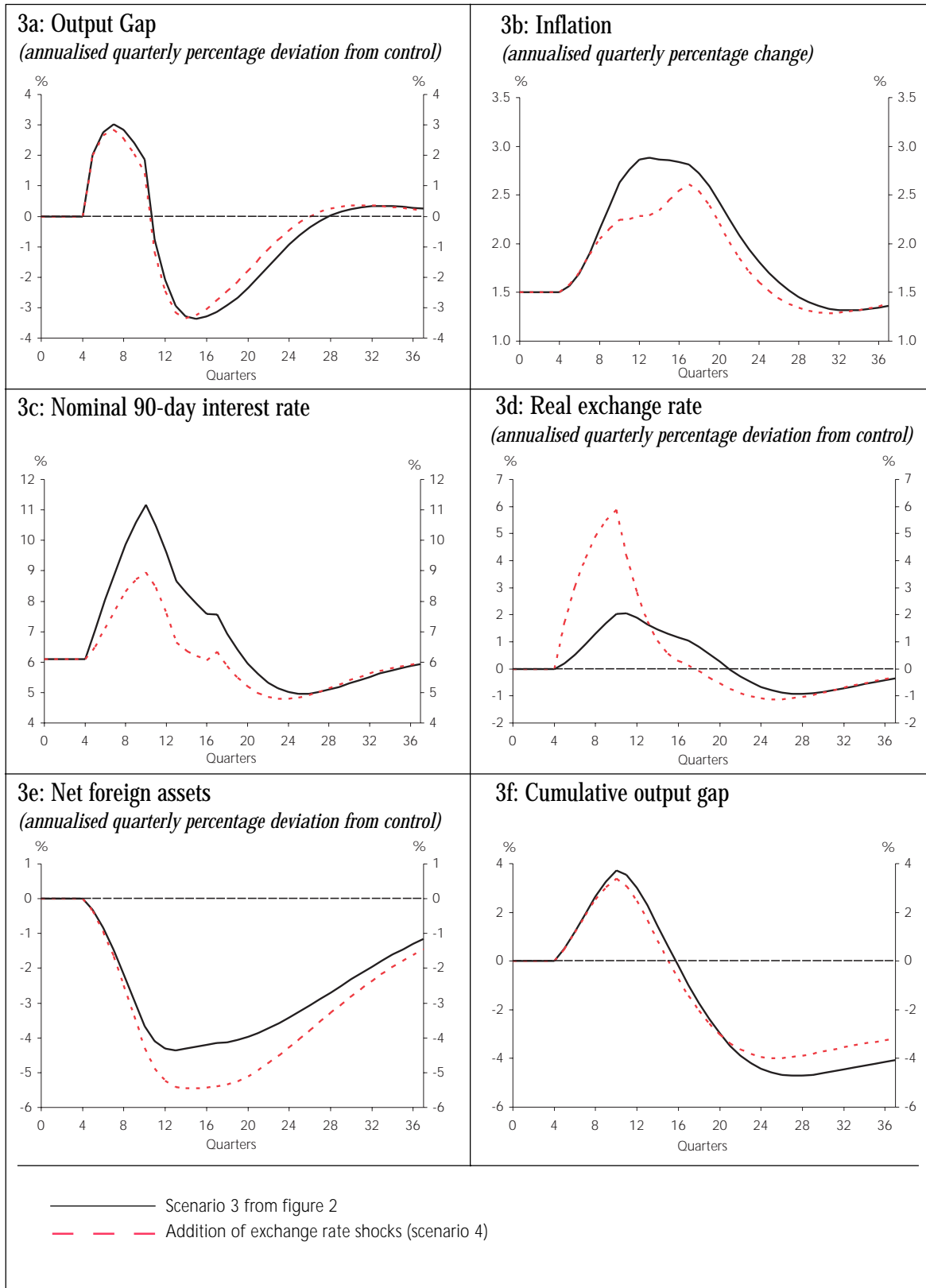
The base case in figure 3 is scenario 3 in figure 2 above, where the economy receives a demand shock which the Bank underestimates, ie, the demand shock scenario we think corresponds most closely with what actually happened. Added to this scenario is a positive real exchange rate shock to give Scenario 4 in figure 3. That is, the real exchange rate is made to rise unexpectedly by one percent per quarter for six quarters (see figure 3d).¹⁰

It can be seen in figure 3 that, as a consequence of the real exchange rate shock, short-term interest rates initially rise by around two percentage points *less* than in the case of the demand shock alone (see figure 3c). The more muted interest rate response reflects the work that the real exchange rate appreciation is doing in containing demand. However, the overall net foreign liability position deteriorates even further (see figure 3e). This occurs as the external sector of the economy bears more of the brunt of the policy tightening. The overall deterioration in the net foreign liability position is around 6 percent of GDP, similar to the size of New Zealand’s current account deficit over the recent business cycle.

¹⁰ This is similar in magnitude to the real exchange rate appreciation experienced in New Zealand from late 1993 to early 1995.

Figure 3: The implications of both underestimating demand, combined with a real exchange rate shock

See the appendix for data definitions and a description of how the variables are calculated.



The policy horizon

The implications of alternative policy horizons can also be examined using FPS. The demand and exchange rate shock simulations already discussed used the 'standard' FPS policy reaction function; that is, short-term interest rates are shifted in response to projected inflation deviating from the mid-point of the inflation target band some 6 to 8 quarters ahead. Figure 4, by contrast, highlights the impact of shortening this policy reaction horizon to 3 to 5 quarters ahead. It can be seen that, under this model, the inflation, output, and interest rate cycles are further accentuated when the horizon is shortened.

By **shortening** the policy horizon, the central bank effectively takes more account of the direct impact on inflation caused by the effect of the appreciation of the exchange rate on the prices of imported items. Accordingly, monetary policy initially is easier, since the rise in the exchange rate leads to initially lower inflation (see figure 4b). The corollary is that the central bank takes less account of inflation pressures arising from the slower-acting positive demand shock. Thus, when the central bank does see the implications of the demand shock, monetary policy has to be tighter for longer relative to what would have been required if policy had been more forward looking. Again, this result may help us think about the recent business cycle.

The phase of the business cycle when monetary policy was probably at the greatest risk of operating over an excessively short-term horizon will have been when inflation was very close to the edge of, or outside, the then 0 to 2 percent target range. During this period, the Bank was very much under the spotlight, and there was, at least for a period, an almost inevitable focus on getting inflation back within the target range as soon as reasonably possible. Despite this focus, the Bank was repeatedly surprised by how long it took for the goal to be achieved. In successive quarters, it was projected that within two or three quarters ahead inflation would fall below 2 percent, but in the event that outcome was not achieved until mid-1997.

There are a number of possible explanations for the unexpected resilience of inflation during the period mid-1995 to mid-1997. A major one, of course, is the combination of surprises already mentioned that boosted demand pressures in the economy. Another possibility is that the Bank was

putting too much weight on the expected direct price benefits of the appreciating exchange rate. At the time, the Bank relied primarily on the 'mark-up' approach to projecting inflation pressures, in which the inflation outlook was based on cost pressures and margins. The exchange rate, through its influence on import prices, was an important driver. With the exchange rate appreciating throughout this period, near-term aggregate inflation pressures were being constrained, despite the more persistent inflation pressures still in the domestic economy.

In hindsight, it could be argued that insufficient attention was initially given to these persistent domestic inflation pressures, which are most influenced by the longer-term impact of the exchange rate and interest rates on, first, demand, and then inflation.

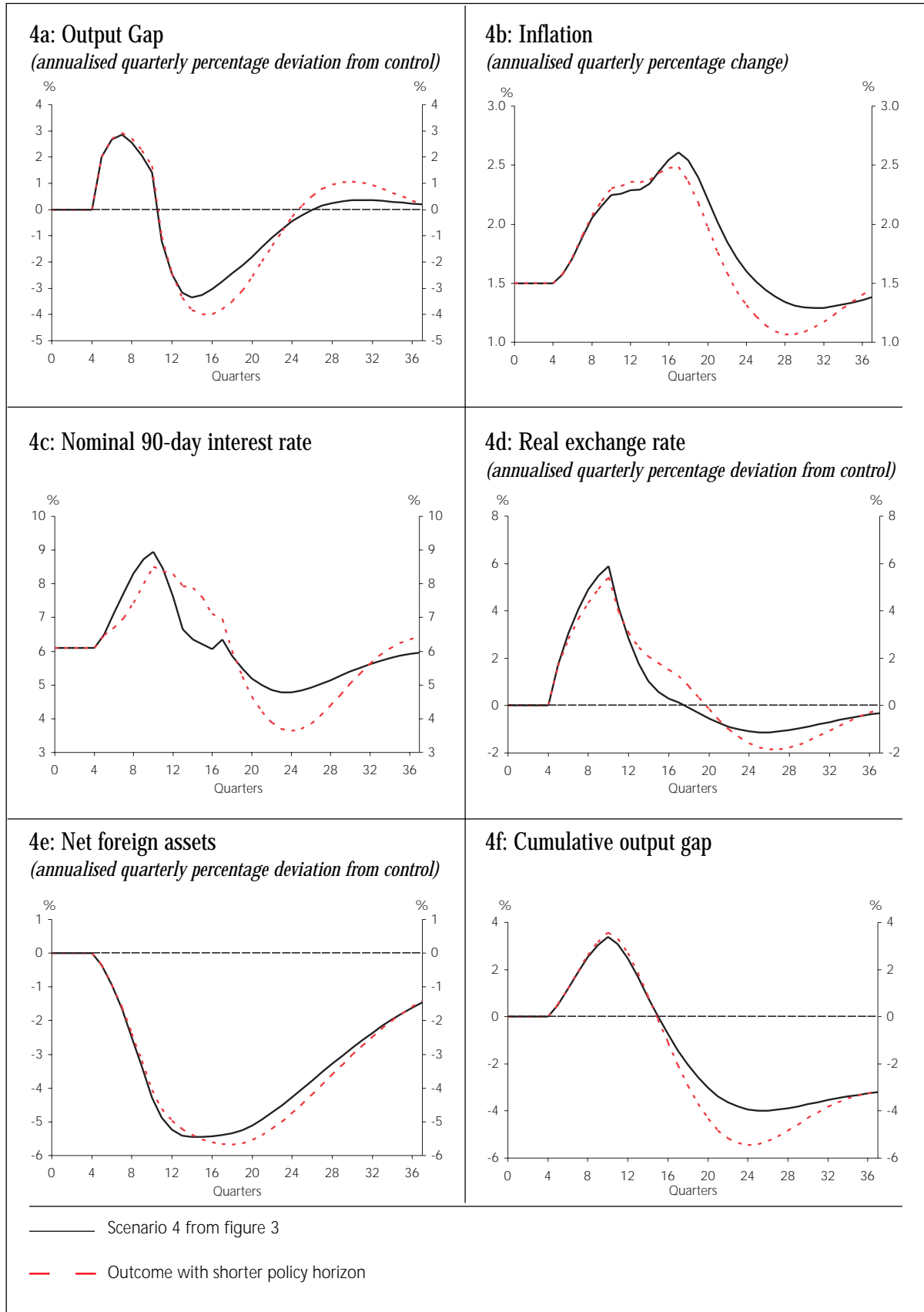
Whatever the full explanation, it was recognised that, however uncomfortable it was to have inflation near or outside of the range, the lag between monetary policy actions and inflation can be quite long. To have lowered inflation to less than 2 percent in short order would have required a degree of monetary restraint beyond that consistent with maintaining price stability in the medium term. Indeed, the concern was that bringing inflation down quickly would have set the economy on a course that would have risked inflation falling below 0 percent in the medium run.

The above simulations clearly highlight some of the ways in which the monetary policy framework and economic shocks can interact with the economy. They show how, given demand pressures and shocks to the exchange rate, combined with a relatively short policy horizon, it became more difficult for monetary policy to maintain price stability over the medium-term than might, ideally, have been possible. With hindsight, reacting sooner to demand shocks and focussing on the persistent, domestic-based inflation pressure may have helped moderate the recent business cycle. However, the simulation results clearly support the Bank's reluctance in early 1996 to aggressively tighten policy in an attempt to quickly reverse breaches of the target range.

Of course, the most important feature of the simulations is that the differences between the scenarios are relatively minor in comparison to the cycle set up by the impact of the underlying shocks. In other words, the differences in eco-

Figure 4: The implications of under estimating demand, a real exchange rate shock, and a short policy horizon

See the appendix for data definitions and a description of how the variables are calculated.



conomic outcomes between adopting alternative monetary policy approaches remain small in comparison to the cycle generated by the initial shocks. This is not to say that monetary policy is not important. What is not shown in the simulations outlined is what the business cycle would have looked like if monetary policy had completely ignored the shocks that occurred. In that case, the cycle would have been of considerably greater magnitude than that actually experienced.

The alternative scenarios presented should therefore be considered more in the nature of refinements to inflation targeting, and not as different approaches that would have reshaped the business cycle in any fundamental sense. Nonetheless, two broad conclusions can be drawn. First, in a world where unexpected events occur – and that will always be the case – it will generally be better for monetary policy makers to identify those surprises quickly and act in a timely fashion. But second, it will generally be the case that the policy response should be formulated with a view to maintaining price stability in the medium-term, rather than over some very near-term horizon.

Flexible versus strict inflation targeting

The scenarios just described illustrate how maintaining low and stable inflation is not incompatible with having a concern for maintaining stability in the economy more generally, for example, in real output and in interest and exchange rates. While the central bank certainly cannot ‘buy’ any permanent increase in output growth, it does have some influence over **volatility** in the economy. In part, these issues concern the choice between ‘strict’ or ‘flexible’ inflation targeting.

A **strict** central bank can be categorised as being concerned only with deviations of inflation from some target level. As such, the strict central bank will aim to have inflation return to its target in the shortest possible time. It is thus likely to be most reactive in its interest rate response to inflation pressures projected as close as, say, 2 to 4 quarters ahead. In an open economy like New Zealand’s, a **strict** central bank would rely more heavily on the **direct** impact of the exchange rate on consumer prices, given its more immediate and transparent impact.

In contrast, a **flexible** central bank attaches some importance to minimising the volatility of output **as well as** returning inflation to its target. It is thus likely to adjust interest rates so as to return inflation to its target more slowly, thereby avoiding large fluctuations in the policy instruments and output. In an open economy, this implies that the central bank places more weight on the **indirect** impact of the exchange rate (and interest rates) on prices.¹¹

From the outset of inflation targeting in New Zealand, the Reserve Bank has recognised these sorts of trade-off. This recognition has been implicit in, for example, the “caveats” in the successive Policy Targets Agreements and the phased approach the Bank took in achieving low inflation.¹² More explicitly, the original target date for achieving price stability was extended, following the 1990 election, from end 1992 to end 1993 on account of the short-run output tradeoff, and, as already mentioned, the Bank in the event reacted reasonably gradually to the breaches of the inflation target range in 1995-96.

Against this background, the decline in and anchoring of inflation expectations achieved in more recent years, in combination with the wider inflation target range since late 1996, has afforded the Bank more flexibility in its policy approach. The advantages of this ongoing flexibility can be examined more formally using FPS, by asking the question: is it possible to reduce the **volatility** in interest rates, the exchange rate and output without unduly increasing the **volatility** in inflation?

In order to address volatility questions, we need to undertake “stochastic” simulations, as described above. That is, we subject the model to a series of random shocks each quarter into the future. This corresponds more closely to the “real world” in which monetary policy operates - where all manner of surprises occur all of the time.

In the experiments reported in this section, the shocks or ‘surprises’ impact on five key macroeconomic variables: the exchange rate, inflation, domestic demand, foreign demand, and New Zealand’s terms of trade. The stochastic simulation technique also accounts for the interaction of these

¹¹ See Svensson (1997).

¹² See Archer and Nicholl (1992).

surprises. For example, surprises to foreign demand or the terms of trade often affect the exchange rate as well. A combination of shocks, taken from New Zealand's own historical experience, is selected randomly to produce 100 simulations each quarter, running 100 quarters into the future (generating 10,000 observations for each variable of interest).¹³

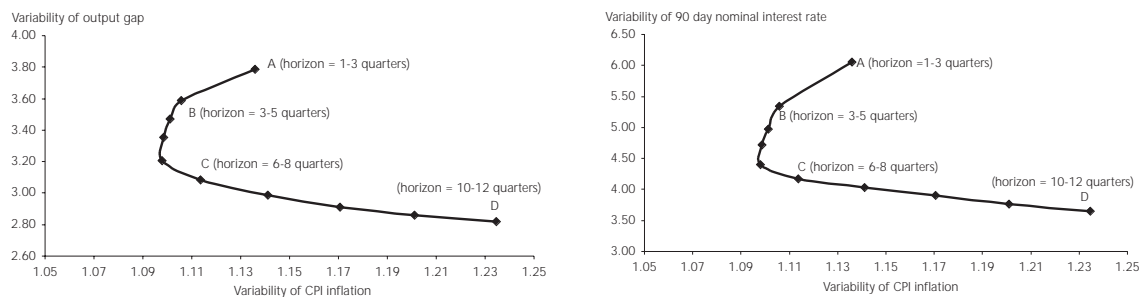
This stochastic simulation process enables us to evaluate alternative monetary policy rules by calculating a **distribution** of outcomes for economic variables such as inflation, output, interest rates and the exchange rate. The relative performance of the alternative implementation strategies can then be compared under identical conditions using objective measures of their performance (in terms of the degree of stability, or volatility, in key economic variables of interest). That is, for each alternative monetary policy rule considered, the variability of each of inflation, output, the exchange rate and interest rates is calculated over the full 25-year period and compared. The monetary policy rule that results in the least variability in these macroeconomic variables over the entire period is considered to be preferable.¹⁴

Alternative policy horizons

The policy horizon currently used in the FPS monetary policy reaction function - that is, how far ahead the model is looking in formulating its response to inflation pressures - has been chosen to reflect views within the Bank, and from wider research. This research suggests that the lag between monetary policy actions and inflation outcomes is between one and two years time. The standard monetary policy reaction function is thus set so that policy responds to projected inflation pressures some 6 to 8 quarters ahead.

Results from simulating FPS with the same battery of shocks, but alternative policy reaction horizons, are shown in figure 5. The left-hand panel plots outcomes in terms of output and inflation volatility under different reaction horizons, while the right-hand panel shows the policy instrument (interest rate) and inflation volatility. The point labelled A relates to the most short-term, or myopic, policy reaction. This short horizon is clearly not 'efficient', given that a more forward-looking rule can reduce instrument, output, *and* inflation variability.¹⁵ Point C is the standard FPS policy rule, and point D is the most forward-looking policy rule considered. It is

Figure 5: Implications of varying policy horizons (percentage deviation from control)



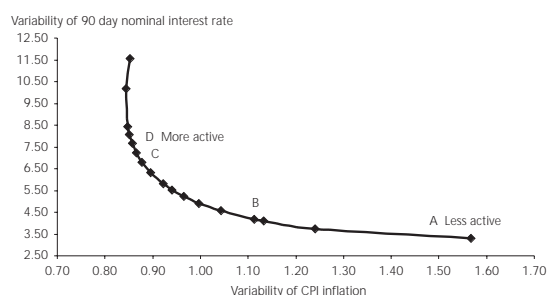
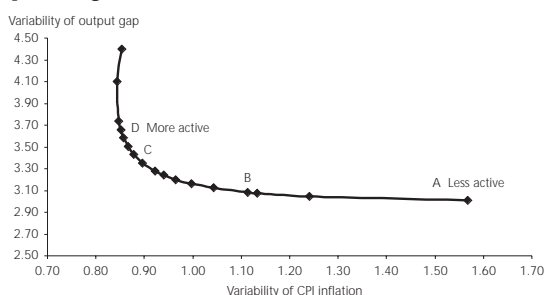
See the appendix for data definitions and a description of how the variables are calculated.

¹³ See Drew, A and B Hunt (1998a) for technical details. See also the appendix for the formula used to calculate the variability measures.

¹⁴ See Drew, A and B Hunt (1998c) for a discussion on alternative monetary policy rules.

¹⁵ The policy rule represented by the point labelled 'A' fares poorly because the monetary authority tries to return inflation to the target over a horizon where inflation outcomes are essentially pre-determined - given the short-run rigidities that exist in the economy. As such, the monetary authority induces instability into the model economy.

Figure 6: The effect of being more vigorous in policy making
(percentage deviation from control)



clear that moving from point C to point D reduces output (and instrument) variability, but at the expense of greater inflation variability.

The results of these simulations suggest that reduced output and instrument variability can be achieved by being forward-looking. However, it is also evident that as the policy horizon is extended much beyond 6-8 quarters (point C), not much is to be gained in terms of reduced output and instrument volatility, while inflation volatility increases quite markedly. This suggests an optimal policy horizon in the vicinity of point C.

It is recognised that these results are not fully independent of the FPS model, which has been constructed on the prior view that policy generally works with a lag of about 6 to 8 quarters. However, the results are not predetermined. The outcomes are generated from the interaction of the monetary policy reaction with the rest of the model - which is constructed to reflect the workings of the New Zealand economy - and thousands of randomly selected shocks representative of the type of disturbances New Zealand has historically faced. In this sense, the results provide independent support representative of the type of disturbances New Zealand has historically faced for a reasonably forward-looking policy reaction function.

A wider or narrower inflation target band

Another question we consider is the degree of flexibility the current 0 to 3 percent inflation target range has brought to policy, compared to the previous target range of 0 to 2 percent. It could be argued that a wider target range allows the Bank to be less active in its policy, with the Bank able to allow more time for projected inflation to return to its midpoint. This type of flexibility is afforded since a wider band means it is less likely that the target will be breached.

Figure 6 presents the results from further FPS stochastic simulations, this time altering the degree of policy activism. Monetary policy is made **more active** by increasing the size of the interest rate response in the model's reaction function to any deviations from the inflation target. Conversely, policy is made **less active** by decreasing this interest rate response coefficient.¹⁶

In the first panel of figure 6, it is seen that the more active the policy response, the lower is inflation variability and the higher is output variability. This illustrates the trade-off between inflation and output variability.¹⁷ The second panel illustrates that, as the variability of inflation is reduced, instrument variability increases.

In figure 6, point B represents the standard FPS policy rule. It can be seen that the cost of reducing inflation variability through increased policy activism is a rise in output and instrument variability.

The probability that inflation will fall within a certain range about the target can also be calculated using these results. The probabilities are shown in table 2. It can be seen that under the standard policy rule, inflation is expected to remain within our current target, of +/-1.5 percentage points

¹⁶ By way of example, in the standard FPS rule (represented by point B) the size of the interest rate response is such that if inflation is projected to be one percentage point above target over the policy horizon, short-term interest rates will be increased by around 140 basis points (ie 1.4 percentage points). Point A is a less active policy rule, whilst points C and D are rules that respond more vigorously to inflation deviations.

¹⁷ See Taylor (1994).

Table 2: Alternative band widths for CPI inflation targeting rules

Band width	Probability that inflation lies within the band with alternative policy reaction rules			
	A (least active)	B	C	D (most active)
+/- 1%	50%	70%	64%	75%
+/- 1.5%	66%	82%	90%	92%
+/- 2%	80%	93%	97%	98%
+/- 3%	95%	99%	99%	99%

around the mid-point, about 80 percent of the time. In contrast, the less active policy rule keeps inflation within the range 66 per cent of the time, while the more vigorous policy rules ensure inflation remains within the band over 90 per cent of the time.

The policy dilemma is thus clear. If the Bank is to be judged purely on its achievement of keeping inflation within the target range, then it is likely to favour a more active policy approach. Or, if the Bank is trying to establish credibility by achieving its inflation target at all points in time, then it is wise to favour a more active approach and a shorter policy horizon.

However, a more active policy with short horizons implies more variability in both output and the instruments. This is why the Bank – and those who monitor its performance – recognised that, although the Bank should be constantly **aiming** to meet the target, it is neither sensible nor realistic to expect that inflation will always be in the range. Indeed, as inflation expectations have become more anchored on the official target over recent years, there has been some shift further in this direction. The Bank has preferred to move towards a less active and longer-term horizon when targeting inflation. This approach may come at the cost of slightly more variable inflation outcomes, although the wider 0 to 3 percent inflation target reduces the probability of the Bank actually breaching its target.

The simulations in this section, of course, should be interpreted as stylised results, rather than as strict quantitative assessments of, for example, the ‘optimal’ inflation target range or the ‘optimal’ policy horizon.¹⁸ Qualitatively, however, the results are intuitively appealing:

- the narrower the target range the more active monetary policy must be;
- more activism implies more **variability** in interest rates, the exchange rate, and output; and (up to a point) less variability in inflation;
- lower inflation expectations and a wider target range allow for a longer policy horizon, and less active monetary policy.

Finally, it is instructive to review how the volatility trade-offs amongst key economic variables have played out in New Zealand relative to other countries. Table 3 ranks the variability of inflation, output growth, the real exchange rate, and the real interest rate for New Zealand relative to 19 OECD countries, over four time periods since 1979. The table also presents (in brackets) the actual variability (or standard deviations) in these economic variables for New Zealand.

In absolute terms, New Zealand’s inflation variability has declined considerably since 1979, and especially since 1990. However, output growth and real exchange rate variability has remained roughly constant. Relative to the 19 OECD countries, New Zealand has moved from having one of the most variable inflation rates in the OECD to one of the least variable. However, output growth variability has remained in the middle of the pack, while New Zealand’s relative exchange rate and interest rate variability have increased. In short, the cross-country ranking results are consistent with the notion that less variability in inflation can be associated with more instrument and output growth variability.

quantitative numbers. Furthermore, policy in practice is not ‘simple’ as characterised by the rules presented. For example, if inflation is projected to go significantly above the band, then the policy reaction of the Bank is likely to be stronger than in the case where projected inflation does not threaten the band. Also note that the variability of the inflation statistic is calculated from a model-generated time series of what is conceptually CPIX.

¹⁸ More sensitivity analyses of the techniques used for stochastic simulations of FPS are required before any great degree of confidence can be placed in the

The wider inflation target, a longer projection horizon, and a less active response to inflation deviations – or in other words, a more flexible policy approach – may go some way to reducing the variability in output and monetary conditions. Nonetheless, it is still relatively early days for the inflation-targeting regime. We have only one full cycle to examine and, as our previous work on the business cycle has highlighted, some of the pressures we faced during that cycle were stronger than usual.

5 Evolving projection methods, data issues and uncertainty

This final section provides a brief overview of the evolution of forecasting methods in the Bank over the recent business cycle. A discussion of some of the data issues is also provided. We conclude that although some significant steps have been taken to improve our forecasting techniques, forecasting will always remain an inexact science. Unexpected events, volatile and delayed data, and uncertainty as to exactly how the economy works will ensure ongoing projection errors. It is for these reasons the Bank must remain forward-looking, but focus primarily on the medium-term trends in inflation pressures that tend to lead to persistent inflation. The Bank must also regularly update its projections, and base its policy stance on a formal analysis of the likely inflation pressures.

Finally, the Bank also finds it useful to publish its projections of inflation and monetary conditions – with suitable precaution – in order to remove one form of uncertainty, namely, that about how the Bank views inflation pressures and the likely stance of policy going ahead.

Projection methods and data

Over recent years the Bank's analytical tools have evolved. The projection methods moved from largely spreadsheet and individual equations to the current Forecasting and Policy System (FPS).²⁰ The spreadsheet-based projections of the mid-1990s – used because of problems with our previous econometric structural models – placed a considerable emphasis on single relationships and 'partial analysis'. Considerable reliance was also placed on relationships such as the 'mark-up' approach to predicting inflation – where price developments were viewed as a combination of unit costs and margin developments, with demand factors playing an indirect rather than direct role in inflation projections.²¹ By contrast, at the centre of the FPS framework is the notion that inflation pressures evolve primarily from excess demand or supply – the so-called output gap. Monetary policy is seen to influence inflation primarily via the **indirect** impact of interest rates and the exchange rate on demand. As a result, a medium-term focus is now at the core of the forecasting process.

Table 3: The relative and absolute variability of New Zealand's output growth, inflation, interest rates and exchange rate ¹⁹

Time period	Inflation		Real GDP growth		Real exchange rate		Real short-term interest rate	
Since 1979	4	(5.4)	7	(2.6)	10	(7.0)	18	(3.8)
Since 1985	1	(4.0)	5	(2.4)	7	(7.1)	13	(2.4)
Since 1990	11	(1.2)	4	(2.6)	7	(7.4)	5	(1.5)
Since 1993	19	(0.4)	6	(1.7)	2	(7.9)	9	(1.2)

Notes to table: The rankings are against 19 OECD countries. 1 = the most variable, 19 = the least variable. The numbers in brackets are the actual standard deviations for New Zealand. Sources: International Financial Statistics, Statistics New Zealand.

¹⁹ Inflation is the annual percent change in the consumer price index, generally exclusive of interest costs. The real exchange rates are calculated using relative CPIs and trade-weighted (or effective) exchange rates. The real interest rates are short term nominal interest rates minus annual CPI inflation. Real GDP growth is an annual percent change.

²⁰ See Drew and Frith (1998).

²¹ See Beaumont *et al.* (1994)

The FPS is also what is termed a 'general equilibrium' framework, which accounts for, amongst other things, the level of assets relative to their 'equilibrium' level in key sectors of the economy. This approach has a number of advantages. In particular, it ensures the Bank takes explicit account of the impact of debt and wealth on demand pressures – a key determinant of the unanticipated inflation pressures in the recent cycle. In addition, the FPS framework provides a useful store of institutional knowledge of how the economy is perceived to operate, the consistency of past forecast judgements, and the evolution of the longer-run features of the economy.

A significant increase in computing power has also enabled FPS both to incorporate an endogenous policy response and make the analysis of risks and uncertainty more rigorous. The Bank can now tackle directly questions such as: 'how would monetary conditions have to evolve over the near-term in order to keep inflation near the mid-point of the target range in the medium-term?' In addition, FPS allows a confidence interval to be placed around monetary conditions, providing a scale for how 'flexible' policy can afford to be between formal interest rate resets.

However, even if the Bank had the 'perfect' model of the economy, forecast mistakes would still occur. Many uncertainties would remain, including the measurement of economic variables and the frequency and magnitude of unexpected events. In particular, the limitation of New Zealand data is well known amongst economic observers. In some cases this simply reflects the short time-series that are available for many economic variables. This makes economic modelling very difficult, with key relationships having to be based on theory and unable to be empirically verified.

When analysing the role of data adequacy in the Bank's past projection errors, two general observations can be made. First, the absolute accuracy of the Bank's short-term forecasts is highly dependent on the variability of the data series being projected. Secondly, the amplitude of any persistence in the Bank's forecast errors is generally exacerbated by data revisions. For example, over the recent business cycle, GDP has tended to be revised up during periods of expansion. Such revisions tended to magnify the extent to which the strength of demand was under-predicted in the mid-1990s.

Absent data is also a concern for forecasters and researchers alike. Some important variables that are not available in New Zealand include an estimate of the capital stock, reliable productivity measures, timely industrial production estimates, and quarterly nominal GDP. For forecasting and monitoring purposes the Bank must estimate, or do without, these series, introducing further sources of uncertainty. Even a perfect economic model will not perform well if its inputs are volatile, missing, or subject to significant revisions.

Managing uncertainty

The forward-looking nature of monetary policy implies that the stance of policy is always conditional on the projections proving broadly correct. Given the degree of uncertainty in forming projections, they will always be surrounded by wide confidence intervals. However, as outlined several times in previous sections of this article, it is the *medium-term* trends in the economy (ie the outlook one to two years ahead) that is most relevant to inflation control, rather than short-term fluctuations.

In this environment, the Bank must still set policy in a timely fashion in order to prevent inflation pressures gathering momentum. However, it must also take explicit account of uncertainty about the economic outlook when deciding if, and by how much, the stance of policy (ie the Official Cash Rate) should be shifted. At any point in time the Bank must assess the current state of the economy, how the economy actually operates, and the balance of risks around the projection. It must balance any monetary policy decision against a concern to avoid excessive instrument instability (ie minimising the size and frequency of policy resets and reversals) and excessive output variability. Unfortunately, there is no single rule for dealing with economic uncertainty. Rather, the Bank has several means at its disposal.

First, the Bank revisits its economic projections every quarter, in order to account rigorously for new information and unexpected developments.

Secondly, the Bank publishes its projections, thereby reducing one form of uncertainty – that about how the Bank views the economy and what its future policy actions might be.

Thirdly, the Bank focuses on the mid-point of the inflation target range (ie 1.5 percent per annum) when setting its

policy stance. This focus maximises the likelihood that future inflation outcomes will be within the target range, and reduces the need for vigorous policy reaction in response to small changes in inflationary pressure.

Fourthly, financial market prices respond to relevant information as it emerges between the Bank's formal monetary policy reassessments. At times, this may pre-empt and perhaps even obviate the necessity for a shift in the policy instrument. If the market knows the Bank's objectives, receives the same information, and understands how the Bank forms its views, then we should expect financial market prices to behave in this way. Under the Official Cash Rate implementation system, the yield curve and exchange rate movements will be likely to exhibit this behaviour, and reflect the Bank's probable next policy move.

6 Conclusions

This article has discussed the monetary policy issues that emerged from the Bank's review of the 1991-98 business cycle. Possibly the most significant conclusion relates to the importance of using a flexible, medium-term, approach to inflation targeting. A key reason why the Bank has felt able to move in this direction has been the rise in public confidence that low inflation is now the norm, not the exception.

One important change in policy focus relates to the role of the exchange rate. Broadly, the policy changes have comprised a shift in focus from the direct impact of the exchange rate on the price of imported goods, to the indirect effect on prices via the real economy and inflation expectations. This shift in emphasis is evinced by, amongst other things, the longer horizon over which inflation is targeted, and the use of the 'output gap' paradigm as central to inflation forecasting. Another important shift is the wider target range for inflation of 0 to 3 percent, which provides additional scope for flexible policy. The Bank is also now firmly focused on the mid-point of the target range one to two years ahead and less on reacting vigorously once the edges of the band are threatened.

The benefit of anchoring inflation expectations near the mid-point of the target range is that the Bank can afford larger, temporary, deviations in actual inflation from the mid-point. This reflects the fact that the Bank recognises that while

monetary policy can not be used to engineer sustainably faster growth in the long term, there can be a trade-off between the variability of the policy instrument and output, and the *variability* of inflation. At the margin, these policy changes may make some difference to the Bank's behaviour in the business cycle ahead.

However, the most significant lesson for the Bank from the recent business cycle is the importance of pre-empting shifts in inflation pressures. If monetary policy is able to adjust in a timely manner, then a significant degree of interest rate, exchange rate and output volatility may be avoided. In particular, it is evident from this review that the Bank's projections underestimated the degree to which rising asset prices and wealth perceptions underpinned demand and inflation pressures in the last business cycle.

There are many additional lessons which both this article, and those in the December 1998 *Bulletin*, make clear. For example, the economy will continue to be buffeted by economic shocks and influenced heavily by events overseas. New Zealand's real exchange rate will also continue to exhibit cyclical trends, influenced by monetary policy and structural factors at home and abroad. Monetary policy also does not act alone in influencing New Zealand's business cycle, with fiscal policy, for example, continuing to have an important impact. Finally, it is important that the Bank and the general public understand that any economic projections will have wide confidence intervals, or degrees of uncertainty. Decision-making occurs in a world of uncertainty and the Bank's present research effort is focussed on how the best decisions can be made in these conditions.

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Appendix: FPS model notation

This appendix describes the key FPS model variables that are used in Sections 4 in figures 2 to 6.

First, in figures 2 to 4, the variables: output, the real exchange rate and net foreign assets are expressed as annualised percent deviations from their implied 'equilibrium' or 'control', values in the FPS core model. The 'equilibrium' refers to the long-run solution path of the FPS model economy. The actual variable definitions are:

Output gap:	Annualised percentage deviation of output from potential output.
Inflation:	Annual CPI inflation.
Real exchange rate:	Annualised percentage deviation of the real exchange rate from the long-run 'equilibrium'. The real exchange rate is calculated by multiplying the nominal TWI exchange rate by the foreign output deflator, and then dividing by the domestic output deflator.
Net Foreign Assets:	Annualised percentage deviation of the Net Foreign Asset position (NFA) from control. Conceptually, NFA represents New Zealand's Net International Investment Position ex migrant transfers.

The formulas applied to calculate the variability measures, seen in figures 5 and 6, (formally called root mean squared deviation (RMSD) statistics), are:

$$\text{RMSD}(y) = \left(\frac{1}{D} \right) \sum_{d=1}^D \sqrt{\left[\left(\frac{1}{T-1} \right) \sum_{t=1}^T \left(\frac{y_{t,d} - y_{con_t}}{y_{con_t}} \right)^2 \right]}$$

Similarly, for CPI inflation and the nominal interest rate, the RMSD statistic is calculated as:

$$\text{RMSD}(y) = \left(\frac{1}{D} \right) \sum_{d=1}^D \sqrt{\left[\left(\frac{1}{T-1} \right) \sum_{t=1}^T (y_{t,d} - y_{con_t})^2 \right]}$$

where:

D is the number of draws in the stochastic simulation experiments.

T is the number of periods (i.e.: quarters) over which the stochastic simulations are run for an individual draw, d .

$y_{t,d}$ is the model solution for a variable y at time t for draw d .

y_{con_t} is the equilibrium control value for the variable y at time t .

The RMSD statistics are calculated - as opposed to sample standard deviations - because we are primarily interested in outcomes that are closest to the 'equilibrium' or 'control' values. See Drew and Hunt (1998a) for further details.