Lessons From Inflation Targeting in New Zealand

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The number of central banks that have adopted formal inflation-targeting regimes expanded over the past decade from only one to eight. The number increases even further when central banks that set policy consistent with a formal inflation target are included.[1] Commensurate with the formal or informal adoption of inflation-targeting regimes, there has been an explosion in the literature on inflation targeting. This literature can be separated into two broad categories. One set examines the macroeconomic data to assess the performance of the inflation targeters and to extract lessons from the inflation targeting experiences of the individual countries concerned.[2] The other set evaluates inflation targeting as a monetary policy strategy, as characterized by a policy rule. A model of the economy is used to assess the stabiliza-

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The material presented here draws heavily on the Reserve Bank of New Zealand's review of the 1991–98 business cycle, as well as papers prepared by the Bank for the 2000 Independent Review of the Operation of Monetary Policy in New Zealand. These papers may be obtained at www.rbnz.govt.nz/monpol/review/index.html. I would like to thank Adrian Orr, Don Brash, Murray Sherwin, Rod Carr, David Archer, Michael Reddell, Bruce White, Anne-Marie Brooke, John McDermott, Geoff Mortlock, Mike Frith, Tim Ng, Paul Conway, and Dean Minot. I would also like to thank Jorge Restrepo for helpful comments.

1. The Reserve Bank of New Zealand was the first to adopt a formal inflation target with the passing of the Reserve Bank of New Zealand Act in 1989. Informally, the Bank had been inflation targeting since 1988. In the 1990s Australia, Canada, Finland, Spain, Sweden, the United Kingdom, and, most recently, the member countries of the European Central Bank have adopted formal inflation targets. Countries that describe themselves as inflation targeters, but that do not necessarily pursue explicit, public commitments to specific targets include Chile, the Czech Republic, Israel, the Republic of Korea, and Mexico.

2. For a recent general assessment of the experience of industrial countries with inflation targeting to date, see Bernanke and others (1999). Recent individual country accounts by central bankers can be found in Allen (1999); Heikensten and Vredin (1998); Thiessen (1998); Stevens (1999); Sherwin (1999).

Inflation Targeting: Design, Performance, Challenges, edited by Norman Loayza and Raimundo Soto, Santiago, Chile.

tion properties of a range of alternative policy rules under deterministic and stochastic disturbances and, increasingly, uncertainty.[3]

This paper combines elements of both strands of the inflation-targeting literature. Some of the key monetary policy issues that the Reserve Bank of New Zealand faced in the 1990s are analyzed using the Bank's economic Forecasting and Policy System (FPS) model. The Bank's policy responses to the specific shocks faced are characterized, and the implications of alternative policy responses to both specific shocks and more generalized disturbances are shown. On the basis of this analysis, the paper highlights two key lessons that the Bank has learned over the last decade. First, inflationary pressures, including those arising from wealth effects, should be preempted to the extent possible. Second, the use of a monetary condition index (MCI) as a guide for policy becomes problematic when economic fundamentals are shifting rapidly.

The paper also explores the rationale behind the evolution of monetary policy at the Reserve Bank of New Zealand. It is likely that as the structure of the economy changes, the lags in monetary policy transmission will also change, and policy design should take this into account. Since the early 1990s, the pass-through into local prices of nominal exchange rate changes has become increasingly muted in New Zealand, effectively lengthening monetary policy's lags (by elevating, in a relative sense, the role of the slower part of monetary policy transmission that works through economic activity). As the Bank has observed this development, it has tended to push out the point in the forecast horizon that it uses to guide policy decisions. This factor, together with the reduction of both inflation and inflation expectations in the 1990s, has led the Bank to adopt a more flexible inflation targeting approach that affords authorities the option of reacting to the more persistent sources of inflationary pressures when deciding on the stance of monetary policy.

The remainder of this paper is structured as follows. Section 1 provides a brief snapshot of the New Zealand macroeconomic data. This is followed in section 2 by an overview of the business cycle experienced in New Zealand in the 1990s. Section 3 examines the impact of specific shocks on the economy, the Bank's policy responses to those shocks, and the potential trade-offs associated with being more or less flexible in policymaking. Concluding comments are provided in section 4.

3. This literature is very large. See, for example, the special issue of the *Journal of Monetary Economics* 43(4) and the references therein.

1. The New Zealand Data Record

Before discussing the role of monetary policy in New Zealand, it is useful to briefly review the broad macroeconomic characteristics of the country in the 1990s. Figure 1 shows how inflation, gross domestic product (GDP) growth, ninety-day interest rates, and the trade-weighted exchange rate evolved after 1990. These are each discussed in turn.

1.1 Inflation

The 1990s represented the first complete decade of inflation targeting in New Zealand, as well as the first decade in a long time in which inflation remained low and stable. After achieving the 0 to 2 percent inflation target in 1991, monetary policy successfully anchored the inflation rate over the remainder of the decade.

From 1991 on, most standard measures of the inflation rate remained below 3 percent, and typically between 1.0 and 2.5 percent. As indicated in figure 1, inflation breached the top of the inflation target band (then 0 to 2 percent) on two occasions: in the second quarter of 1995 and throughout 1996. The Bank's measure of underlying inflation never came close to breaching the lower edge of the target; in fact, it never fell into the bottom half of the 0–2 percent target band. Inflation of the consumer price index excluding credit services (CPIX) fell to a trough of about 1 percent in late 1998 following a number of adverse shocks.[4]

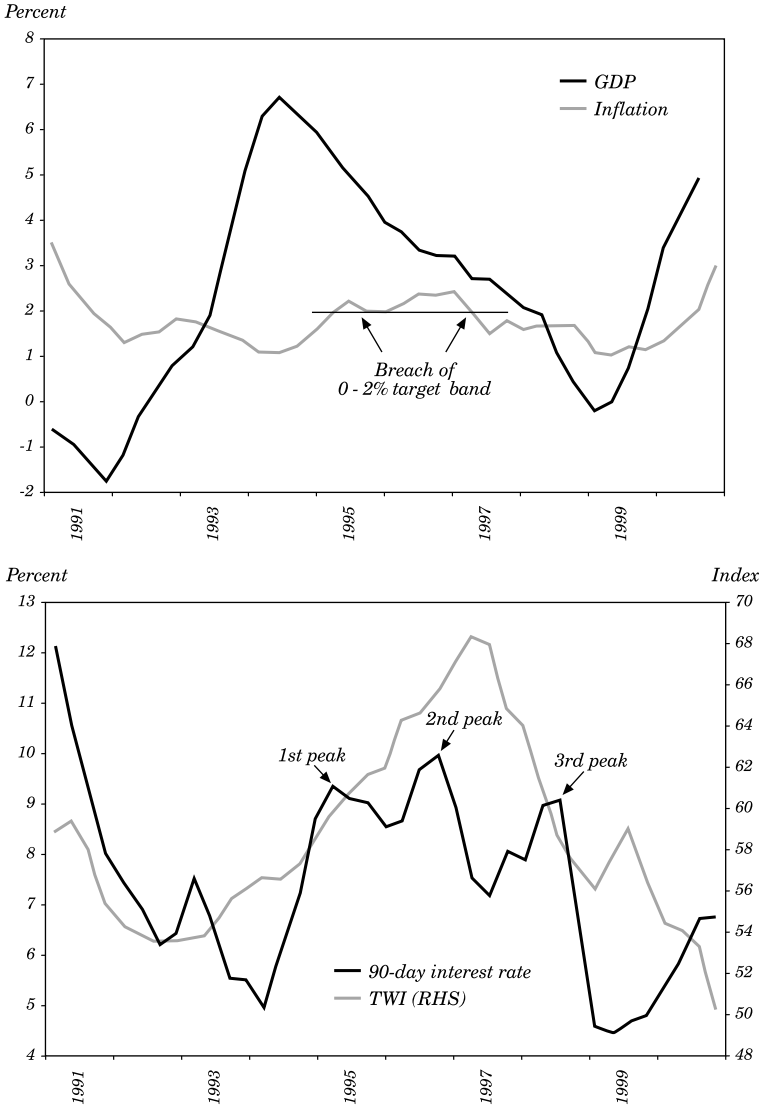
To put New Zealand's inflation record in an international context, figure 2 compares New Zealand's average rate of CPIX inflation since 1991 with the average for the member countries of the Organization for Economic Cooperation and Development. The average inflation rate has been very similar to the OECD average since 1995; before that time it was slightly lower, reflecting the earlier steps taken in New Zealand to bring inflation down.

1.2 Output

New Zealand experienced a significant recession in the early part of the decade, followed by a strong boom in the mid-1990s. Growth then

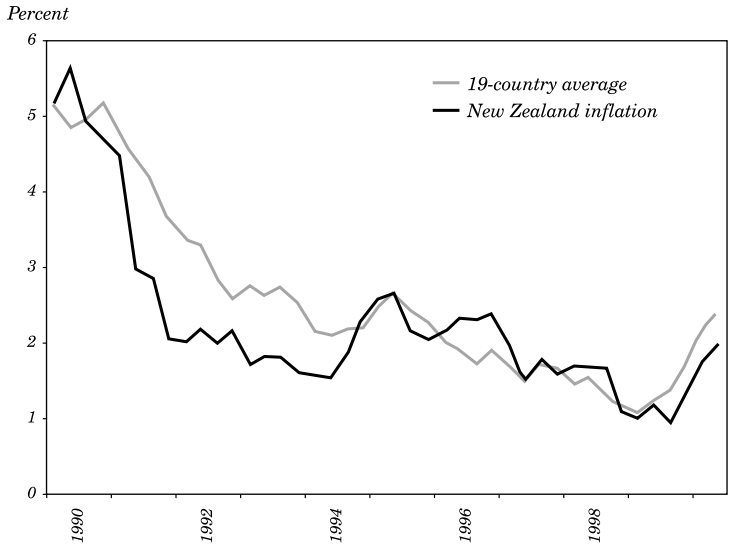
4. The Reserve Bank of New Zealand calculated and targeted underlying inflation from 1989:1 to 1997:3. It then targeted the CPIX from 1997:4 to 1999:2. Since 1999:3, the Reserve Bank has targeted headline CPI. Note, however, that Statistics New Zealand redefined headline CPI in 1999:3 such that it does not include interest charges.

Figure 1. Real GDP Growth, CPI Target Measure of Inflation, Ninety-Day Interest Rates, and the Nominal TWI[a]



Source: Statistics New Zealand, Reserve Bank of New Zealand.
a. GDP growth is an annual average percent change. Inflation is measured as an annual percent change. The inflation series is a spliced series of the CPI measures targeted by the Bank at different periods. These are the underlying inflation rate, the CPI excluding credit services, and the current CPI measure.

Figure 2. CPIX Inflation in New Zealand and the OECD[a]
Annual percentage change



Source: Statistics New Zealand and *International Financial Statistics*.
a. The OECD inflation rate is a nineteen-country average, including Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

slowed gradually, culminating in a small contraction in GDP in the first two quarters of 1998. GDP accelerated quite quickly out of the 1998 trough before returning to more moderate growth rates.

Average GDP growth rates in the 1990s were higher than those in previous decades: real GDP growth averaged 2.5 percent during the 1990s, compared with 1.8 percent and 1.7 percent in the 1970s and 1980s, respectively. New Zealand's average GDP growth in the 1990s was also quite respectable compared with that of other industrialized countries. In a sample of eighteen industrialized economies, New Zealand's average GDP growth in the 1990s was sixth highest, although the strong average growth relative to the growth in many European economies was partly due to a faster growth in the work force in New Zealand (see table 1). The variability of output growth in New Zealand was also lower in the 1990s compared to the 1970s and 1980s.[5]

5. See "Output Volatility in New Zealand" at www.rbnz.govt.nz/monpol/review/index.html for a detailed analysis of New Zealand's output variability and how this compares to other industrialized countries.

Table 1. Real GDP Growth in the 1990s

Percent

Country	*Average growth rate*
Ireland	6.8
Australia	3.5
Norway	3.3
United States	3.2
Netherlands	2.9
New Zealand	2.5
Spain	2.5
Canada	2.4
Denmark	2.2
Belgium	2.1
Germany	2.0
United Kingdom	2.0
France	1.7
Finland	1.7
Italy	1.4
Sweden	1.3
Japan	1.3
Switzerland	0.9

Source: Datastream; Statistics New Zealand

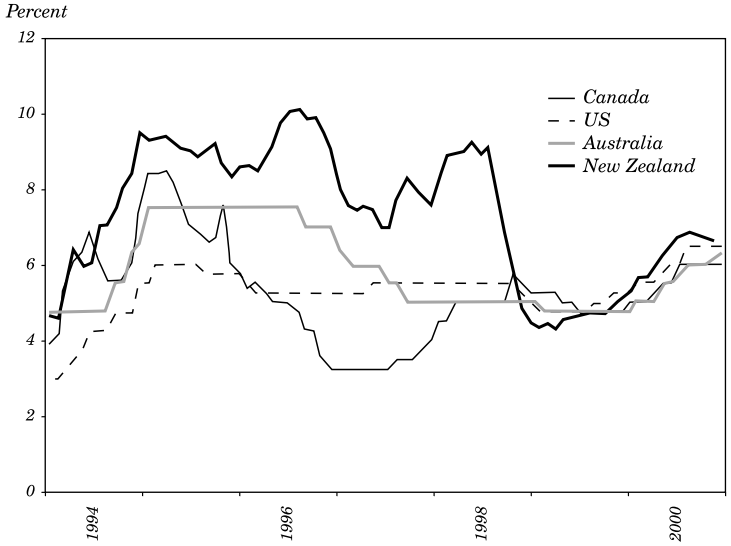
1.3 Interest Rates

The path of interest rates through the 1990s featured three humps: 1994–95, 1996, and 1997–98 (see figure 1). From late 1994 to early 1997, ninety-day rates in New Zealand averaged about 9 percent. This was in response to strong inflationary pressures, as discussed in following sections.

Following the 1996 peak, interest rates fell markedly to around 7 percent in early 1997, before rising again between mid-1997 and mid-1998 to nearly 10 percent. This increase in interest rates coincided with the Bank's use of the monetary conditions index (MCI) to signal the policy stance, which is discussed in detail in Section 3. Following the third peak, interest rates fell from about 9 percent to 4 percent in the latter half of 1998. They then rose gradually to just over 6.5 percent in 2000.

Figure 3 provides a cross-country comparison of short-term interest rates over this period. Because different countries feature different inflation rates, different risk premiums, different cyclical demand pressures, and other distinctive characteristics, however, a simple comparison of nominal interest rates does not always provide a good

Figure 3. Short-Term (Official) Interest Rates of Dollar Bloc Countries[a]



Source: Reserve Bank of New Zealand, Reserve Bank of Australia and Datastream.
a. The short-term rates charted are the US federal funds target rate; the Bank of Canada bank rate; the Australian cash rate; and the New Zealand 90-day bank bill rate. Australia's three-month bank bill rate tracks the Reserve Bank of Australia's official cash rate closely during this period.

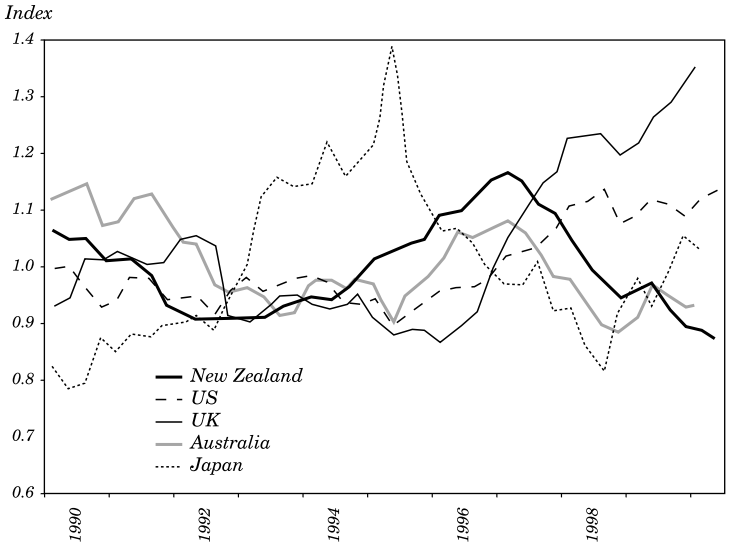
indication of the relative tightness of monetary policy in the countries under consideration.

1.4 The Exchange Rate

The bottom panel of figure 1 depicts a significant cycle in the New Zealand trade-weighted exchange rate index (TWI). After an appreciation of around 30 percent between the first quarter of 1993 and the first quarter of 1997, the TWI subsequently depreciated by around 30 percent. With respect to the U.S. dollar, the New Zealand dollar fell from a post-float high of nearly 72 cents in November 1996 to an all-time low of less than 40 cents in October 2000.

New Zealand was not alone in experiencing large exchange rate fluctuations. Figure 4 plots New Zealand's real effective exchange rate alongside similar measures of the exchange rate for four other countries. Although the amplitude of the cycle of the Australian exchange rate was lower than that of the New Zealand exchange rate, the swings in the yen and the pound sterling were larger than those of the New Zealand TWI.

Figure 4. Real Effective Exchange Rates for Selected Countries[a]



Source: International Monetary Found (IMF), *International Financial Statistics;* Reserve Bank of New Zealand.
a. The exchange rates shown are the real effective exchange rates as calculated by the International Monetary Fund, except for New Zealand where a CPI-based real trade-weighted exchange rate has been used. All the exchange rates have been re-based so that the respective indexes average 1.0 over the period shown.

2. The Business Cycle in New Zealand in the 1990s

New Zealand experienced a strong expansion in output from 1991 to 1997 relative to the economy's recent history as well as contemporaneous OECD country experiences.[6] This expansion was propelled by the flow on effects of structural reform undertaken in the late 1980s and by the traditional factors driving the business cycle, including robust world demand, high commodity prices for New Zealand's exports, strong net inward migration flows, high levels of business and consumer confidence boosting both consumption and investment expenditures, and later, expansionary fiscal policy.[7]

6. Using the National Bureau of Economic Research (NBER) levels-based definition of the business cycle, Brook, Collins, and Smith (1998) show that the expansion in the 1990s lasted two years longer than the previous two expansions experienced in New Zealand. They also find that output growth in New Zealand was above an eighteen-country average of selected OECD countries from 1993 to 1996.

7. For an account of the nature and scope of the New Zealand reform program, see Evans and others (1996). Brook, Collins, and Smith (1998) provide an in-depth discussion on how the reforms and cyclical pressures shaped the 1991–97 business cycle.

Inflationary pressures were strong as a result of the rapid and prolonged expansion in demand over the mid-1990s, and monetary conditions were held firm for an extended period to counter the pressures. Nominal short-term interest rates were increased over the course of 1994 from under 5 percent to almost 10 percent, as shown above in figure 1. Real short-term interest rates also rose substantially above the OECD average in 1994, and they remained high until late 1997. This monetary tightening, together with the general attractiveness of New Zealand as a destination of international capital, led to the substantial appreciation of the real exchange rate seen in the figure.[8]

The tight monetary conditions successfully held overall CPI inflation (less interest costs) within a tight band of 1.5 to 3.0 percent over the period. This stands in marked contrast to New Zealand's longer inflation record, which has generally been poor.

In late 1996 policy was eased as inflationary pressures began to wane, but three large negative shocks turned the desired soft landing into an unexpectedly harsh one. First, the East Asian crisis of 1997 significantly affected both the volume and value of New Zealand's exports.[9] Second, on the supply side, agricultural production contracted after over a year of severe drought. Finally, a change in national immigration policy caused net migration to swing very quickly from positive to negative. These factors, together with the previously tight monetary conditions, caused GDP to contract by nearly two percent over the first half of 1998. After that point, the economy grew moderately, assisted by a very competitive real exchange rate. The growth has yet to be balanced, however, as the most significant contributions to growth have occurred in the externally exposed sectors of the economy.

3. Key Policy Issues

Debelle and others (1998) and Bernanke and others (1999) reach the general conclusion that New Zealand's experience with inflation targeting, like that of other formal inflation targeters, has been positive. The relatively strong growth performance of the 1990s occurred in an environment in which inflation remained low and stable, in contrast to the economy's longer historical record. Perhaps not surprisingly, this conclusion is also endorsed by the Reserve Bank of New

8. See White (1998) for an account of the pressures on the exchange rate in addition to the monetary tightening.

9. East Asia accounts for over 40 percent of New Zealand's exports, and exports amount to around 30 percent of GDP.

Zealand.[10] This is not to say that it has all been plain sailing, however. To quote the Bank's main submission to the *Independent Review of the Operation of Monetary Policy,*

> With the benefit of hindsight, there are occasions in the 1990s when our assessments missed the mark. Two are worth noting. We were slow to recognize the pace of acceleration of the economy in 1992/93, and slow to recognize the joint impact of the Asian crisis and the beginning of an extended drought through 1997 and early 1998. But we would argue that we responded quickly when we recognized the emerging problem—quickly enough to prevent these large inflationary and deflationary impulses to the economy from causing substantial price instability and even larger and more costly swings in the real economy.

The Bank's approach to inflation targeting has evolved as structural relationships in the economy have altered, as it has learned from past errors and from the experiences of other inflation targeters, and as the academic research on inflation targeting has advanced. This section addresses the following two questions in relation to these issues. What lessons can be drawn from the specific shocks that occurred in New Zealand in the 1990s and the way monetary policy responded? How forcefully should monetary policy respond to more generalized disturbances, and how wide does the inflation target band need to be to reasonably accommodate most shocks? The analysis is based on deterministic and stochastic simulations of the Bank's macroeconomic model, the FPS.[11] These simulations are intended for illustrative experiments only. They do not tell us with precision how the Bank should have structured monetary policy in the past or it should do so in the future.

10. See Sherwin (1999).

11. The Forecasting and Policy System (FPS) is a large, calibrated, dynamic general equilibrium (DGE) model with the same generic structure as the Bank of Canada's Quarterly Projections Model (QPM) (see Colleti and others, 1996). These models have a two-tiered structure. The first is an underlying steady-state structure, characterized by a neoclassical balanced-growth path and based on optimizing principles. The second tier models dynamic adjustment to the steady-state path. The adjustment processes (both expectational and intrinsic) are calibrated to reflect the business cycle dynamics of the economies concerned. Although there are many sources of inflation in FPS, fundamentally it arises from the deviation of output from potential output. The monetary authority enforces a nominal anchor via a policy reaction function that sets the short-term interest rate in response to forecasted inflation deviations from the target. See Black and others (1997) for a complete description of the properties of the FPS core mode. Drew and Hunt (1998a) discuss how the FPS is used to prepare economic projections at the Bank.

3.1 Deterministic Simulations

This section reports the results of four sets of experiments undertaken to investigate the following questions. What would have happened if the Bank had better anticipated the increase in demand pressures that occurred in the mid-1990s? 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 during this time? In formulating policy responses to the specific disturbances, how much difference does the policy horizon make? What are the implications of using an MCI to guide policy in the context of a fall in the currency that is initially seen as a portfolio shock, rather than as a necessary adjustment to evolving real conditions abroad? Each of these questions is addressed in turn.

Household expenditure and debt

A feature of the expansion that occurred in the mid-1990s was that consumption growth outstripped income flows, leading to substantial increases in household debt. This was also observed at the national level: the ratio of New Zealand's net foreign assets (NFA) to GDP deteriorated considerably following a sequence of substantial current account deficits.[12]

The deterioration observed in NFA is consistent with households borrowing against their increased wealth, or saving less out of current income, to finance current consumption. Such behavior can be explained by standard economic theory. An increase in household wealth that households perceive to be permanent will have important so-called wealth effects on consumption. The difficulty, of course, is to quantify the extent of these effects ex ante. As discussed in Drew and Orr (1999), the Bank's inflation projections over the early 1990s did not adequately incorporate the impact on demand of households anticipating future wealth and income growth.

12. In 1992, New Zealand's nominal NFA-to-GDP ratio was around –0.72; by 1997 this had deteriorated to around –0.84. A large part of the deterioration was due to foreign investment inflows, which in a sense represented a vote of confidence in the New Zealand economy by foreign investors. The other side of the coin, however, is that New Zealander's reluctance or inability to finance the capital expansion effectively increased our indebtedness to the rest of the world, as represented by the deterioration in the NFA position. See Collins, Nadal de Simone, and Hargreaves (1998) for a more developed exposition of this issue.

Because FPS explicitly accounts for asset stocks, it can be used to examine the implications of misperceiving the willingness of households to incur debt to support consumption. I consider two alternative specifications of the model's behavioral equation for consumption of forward-looking agents. In one specification consumption is curtailed relatively strongly as the NFA-to-output ratio deteriorates from equilibrium; in the other the deviation is tolerated to a greater extent. The following three equations are a stylized representation of the dynamic structure for consumption in the model:

$$c_t = crt_t + cfl_t$$

$$crt_t = ydrt_t, \text{ and}$$

$$cfl_t = cfl\_eq_t + \alpha\left(\frac{ydfl_{t-2}}{ydfl\_eq_{t-2}} - 1\right) - \beta\left(rn_{t-2} - rn\_eq_{t-2}\right) + \delta\left(nfa_t - nfa\_eq_t\right) - cfldaj_t,$$

where c_t is aggregate consumption, crt_t is consumption by rule-of-thumb agents and cfl_t is consumption by forward-looking agents.[13] Rule-of-thumb consumers are liquidity constrained in that they consume 100 percent of their after-tax real disposable income, $ydrt_t$. Forward-looking consumers earn income and hold financial assets, consisting of government bonds, the capital stock, and NFA (which is negative to reflect the New Zealand data). Their desired or equilibrium path for consumption, cfl_eq_t, is determined by solving for a utility maximization problem.[14] Actual consumption of forward-looking agents deviates from equilibrium when real disposable income, $ydfl_t$, deviates from its equilibrium path, $ydfl\_eq_t$; when monetary policy moves away from neutral, $rn_{t-2} - rn\_eq_{t-2}$; and when NFA, nfa_t, deviates from its equilibrium path, nfa_eq_t. The term $cfladj_t$ refers to a polynomial adjustment cost equation along the lines of Tinsley (1993). The coefficients α, β, and δ determine the strength that any disequilibrium has on the dynamic path for *cfl*. Finally, all stocks and flows are expressed relative to output.

The coefficient δ represents the extent to which forward-looking consumers tolerate their wealth deviating from equilibrium. Following any temporary disturbance that moves NFA from equilibrium, the smaller δ is, the less forward-looking agents adjust their consumption behavior to

13. The portion of agents that are rule of thumb in the model is 30 percent.
14. See Frenkel and Razin (1992) for a complete specification of the problem.

maintain their overall financial asset position. Given that NFA is negative, any shock that moves NFA below equilibrium effectively increases the indebtedness of forward-looking agents to the rest of the world.

In the standard version of FPS used for Bank projections, $\delta = 0.12$. An alternative specification of the model increases the coefficient to 0.3.[15] Each model is then hit with a sequence of exogenous positive demand shocks of one percentage point per quarter for six quarters, applied to reflect the cyclical demand pressures faced in the mid-1990s.[16] In the first quarter of the experiment, the monetary authority observes the current demand shock only and sets policy based on its projection of inflation. In the second quarter another demand shock arrives and policy is reset, and so on for the remaining four quarters.

Three alternative scenarios are explored (see figure 5):

—Households have a relatively large appetite for debt, in which case the shock is significantly accommodated by allowing NFA to deteriorate ($\delta = 0.12$).

—Households have a relatively small appetite for debt ($\delta = 0.3$).

—Households have a relatively large appetite for debt, but the Bank sets policy assuming households have a small appetite. In other words, the Bank underestimates the extent to which the shock can be accommodated by an additional deterioration in the NFA position and thus underestimates the medium-term spending pressures in the economy.[17]

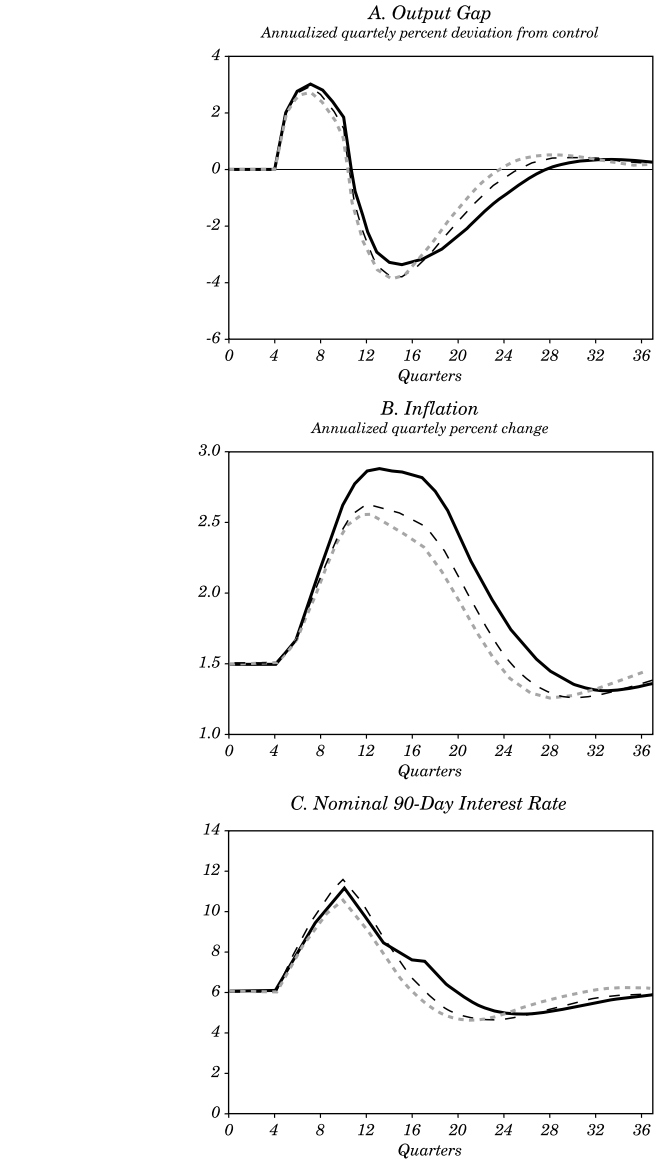
In all three scenarios the unexpected increase in demand leads to an increase in inflationary pressures (see panel B of figure 5). The central bank responds to the inflationary pressures by raising short-term interest rates, which leads the exchange rate to appreciate via an uncovered interest parity (UIP) condition (see panels C and D of figure 5). The eventual slowdown in demand occurs via four main paths. First, domestic consumption falls as forward-looking agents increase savings in response to the elevated interest rates. Second, the cost of capital increases

15. To quantify the impact of changing this coefficient, the rate of savings out of current income was compared under the two coefficient sizes following a one-quarter, one percentage point shock to demand. In both cases, the household savings rate fell as households increased consumption relative to current income. When the coefficient was 0.3, however, the savings rate fell by approximately 2 percent less than under the coefficient of 0.12, reflecting agents' greater reluctance to tolerate the deterioration in the NFA position.

16. Approximately two-thirds of the demand shocks are applied to the model's behavioral equation for consumption and one-third to the behavioral equation for investment.

17. This experiment examines what is essentially one aspect of model uncertainty. For a technical description of the technique employed to examine model uncertainty using models of the same generic form as FPS, see Laxton, Rose, and Tetlow (1994).

Figure 5. The Implications of Underestimating Demand



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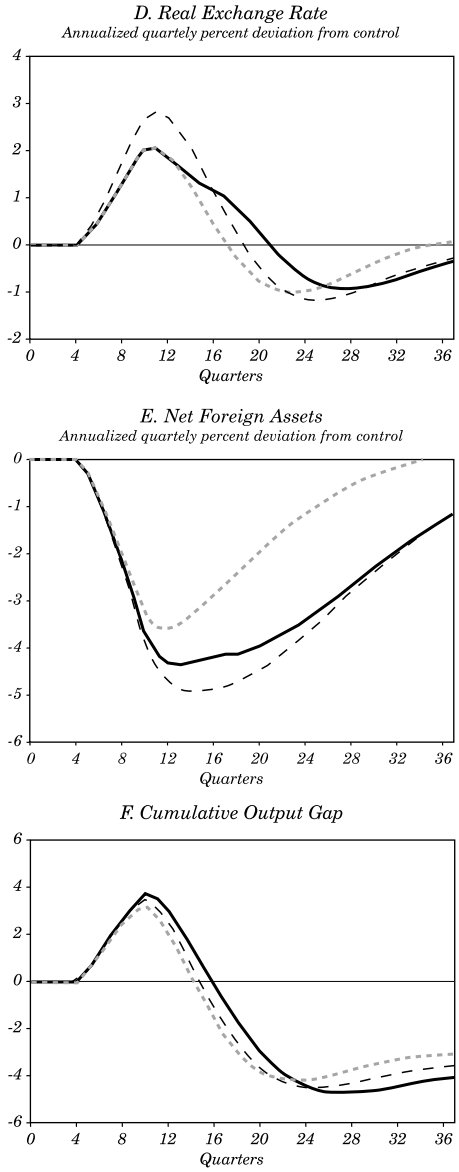


– – *Households have a large appetite for debt (scenario 1)*
Households have a small appetite for debt (scenario 2)
— *Bank underestimates debt appetite (scenario 3)*

Source: Author's calculations.

and investment falls. Third, the exchange rate appreciation causes exports to fall and imports to rise. Finally, the decline in net exports arising from the exchange rate appreciation, together with an increase in the servicing cost of NFA arising from the policy tightening, leads to a further decline in the NFA position (see panel E). Households respond to the deteriorating NFA position by curtailing current consumption, most noticeably in the scenario in which households have a low tolerance for allowing NFA to deteriorate from equilibrium (scenario 2).

The most interesting case, however, is that in which the Bank assumes households have a relatively small appetite for debt when, in fact, the opposite is true (scenario 3). This broadly corresponds to the unexpected increase in household and national debt that was observed over the period 1991–98. In this scenario, the Bank underestimates the inflationary pressures (leading inflation to peak at around 0.5 percentage points higher, as shown in panel B of figure 5) and initially does not respond as aggressively as in the previous case. The net result is that the Bank must eventually tighten policy for a longer period, which prolongs the need for elevated real interest rates and an elevated real exchange rate (see the solid lines in panels C and D).

The results are consistent with the way in which interest rates in New Zealand remained above the OECD average throughout the cycle, thus accounting for some of the appreciation seen in the New Zealand dollar. The results suggest that if the initial policy response to rising demand had come earlier or been more aggressive, and had wealth effects been better understood, the duration of the upward pressures on interest and exchange rates might have been noticeably shorter.

Exchange rate shock

The real exchange rate appreciated strongly during the recovery phase of the recent business cycle. Some of this appreciation can be attributed to the rise in real interest rates needed to contain inflation. Additional factors may also have temporarily supported the exchange rate. As discussed in White (1998), exceptionally low interest rates in Japan (and to a lesser extent in Europe) and the favorable marketing of New Zealand as an investment destination may have added to a strong demand for New Zealand dollar assets.

Figure 6 illustrates the impact of such a positive real exchange rate shock, on top of the demand pressures just examined. The base case in the figure is scenario 3 in figure 5, in which the economy receives a demand shock that the Bank underestimates (and which is the

Figure 6. The Implications of Underestimating Demand with Shocks to the Real Exchange Rate

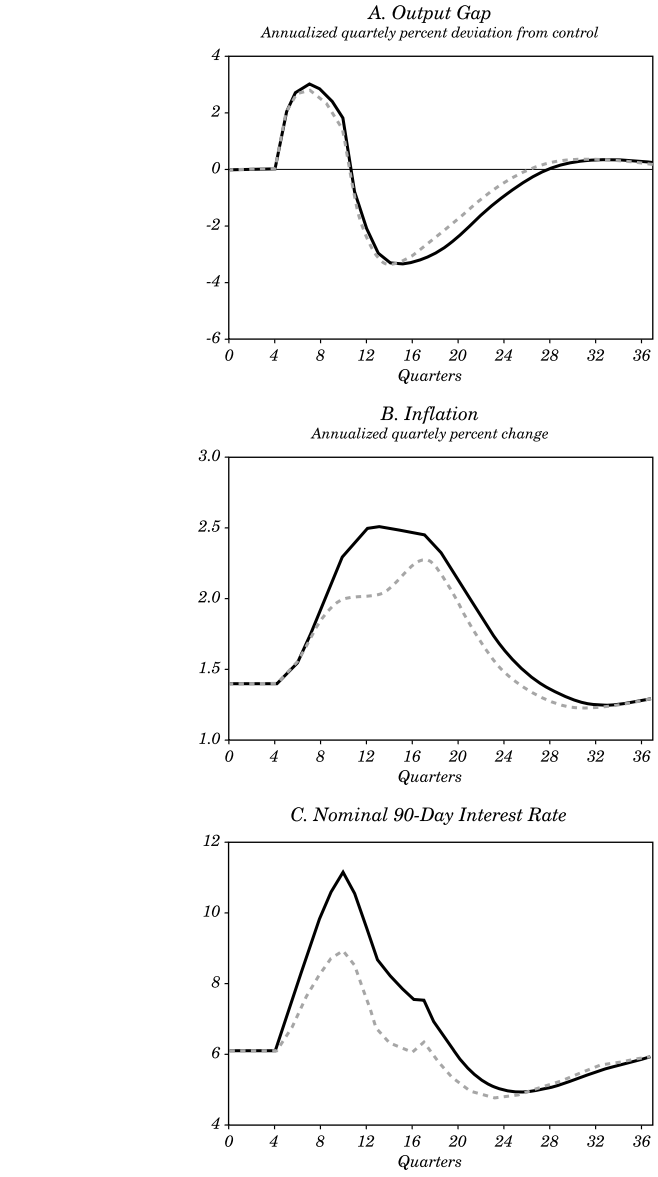
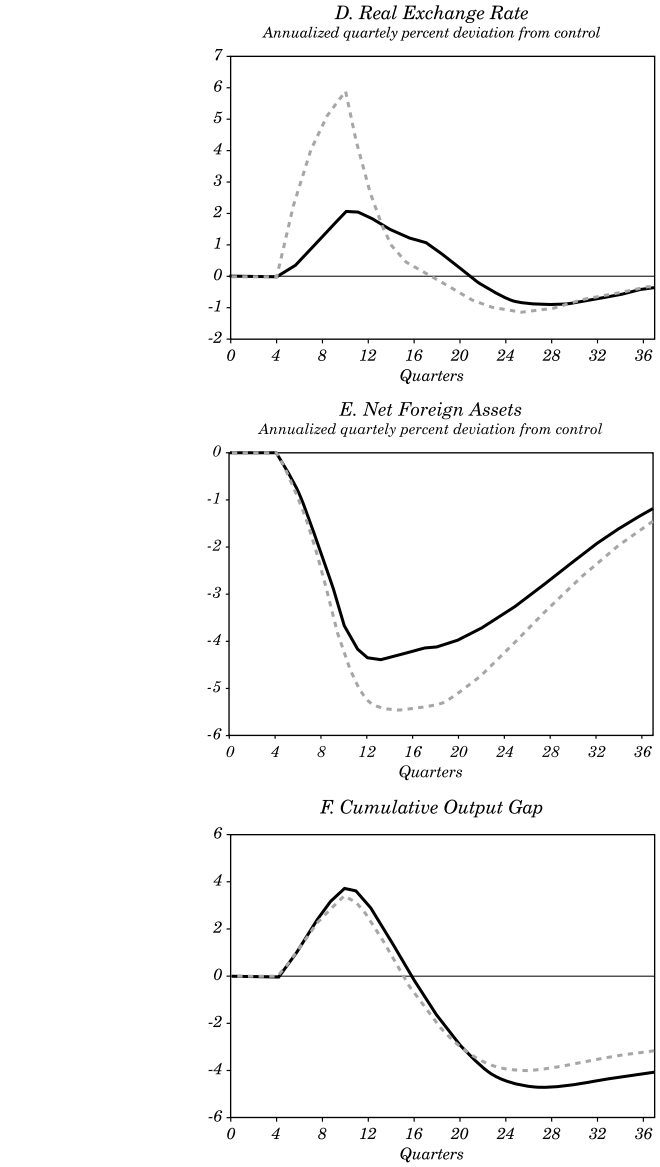


Figure 6. (continued)



Source: Author's calculations.

demand shock scenario that corresponds most closely with what actually happened). This situation is compared to a positive real exchange rate shock (scenario 4). That is, the real exchange rate is made to rise unexpectedly by one percent per quarter for six quarters (see panel D in figure 6).[18] As with the demand shocks, the monetary authority sets policy each quarter observing only the contemporaneous disturbances.

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 panel C). The more muted interest rate response reflects the work that the real exchange rate appreciation is doing to contain demand. However, the overall NFA position deteriorates even further (see panel E). This occurs as the external sector of the economy bears more of the brunt of the policy tightening. The overall deterioration in the NFA position is around 6 percent of GDP, similar to the size of the observed deterioration in this asset stock.

The policy horizon

The generic monetary policy reaction function used in Bank projections is an inflation-forecast-based (IFB) policy rule of the form,

$$rs_t - rs_{t-1} = \alpha\left[rs_t^* + \sum_{i=1}^{j}\theta_i\left(\pi_{t+i}^e - \pi^T\right)\right] - \alpha rs_{t-1},$$

where rs_t is the nominal ninety-day rate at time t, rs_t^* is the neutral ninety-day nominal interest rate, π_{t+1}^e is the model's forecast of inflation at time $t+i$ and π^T is the mid-point of the Bank's inflation-target band (that is, 1.5 percent). The parameter α is an interest rate smoothing constraint, and the parameter θ specifies how strongly interest rates respond to projected deviations of inflation from the target.

The demand and exchange rate shocks described above use 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 six to eight quarters ahead. Figure 7 highlights the impact of shortening this policy reaction horizon to three to five quarters ahead. Under this model and given the shocks applied, the inflation, output, and interest rate cycles are further accentuated when the horizon is shortened. This result is discussed more generally in the next section.

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

Figure 7. The Implications of Underestimating Demand, with Shocks to the Real Exchange Rate and a Short Policy Horizon

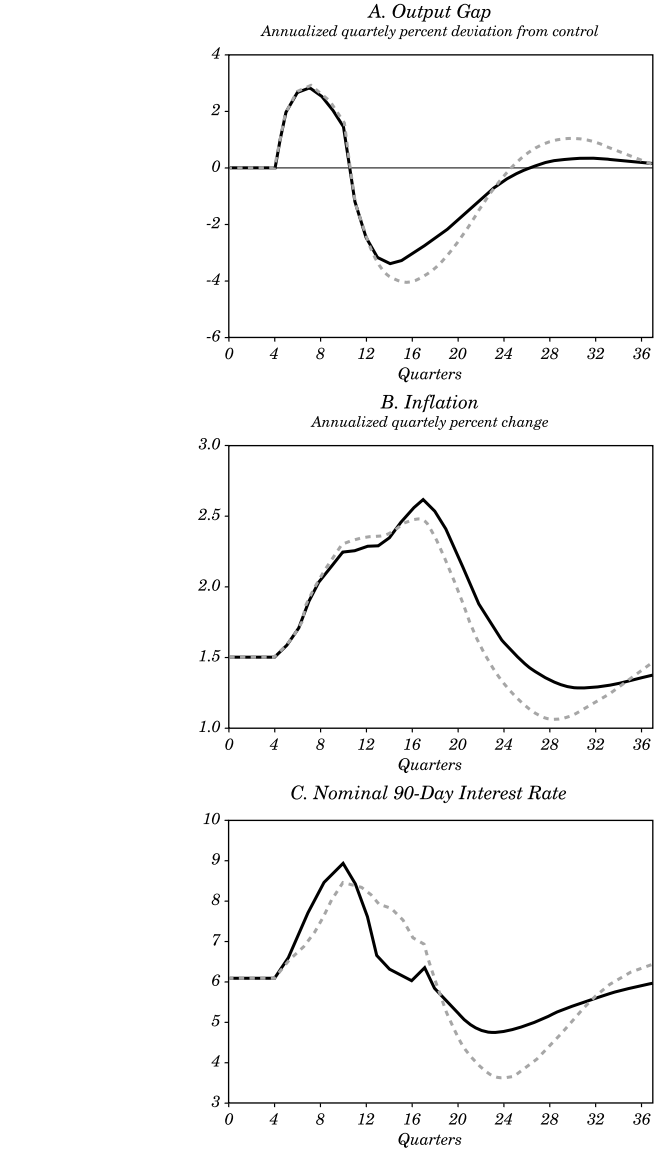
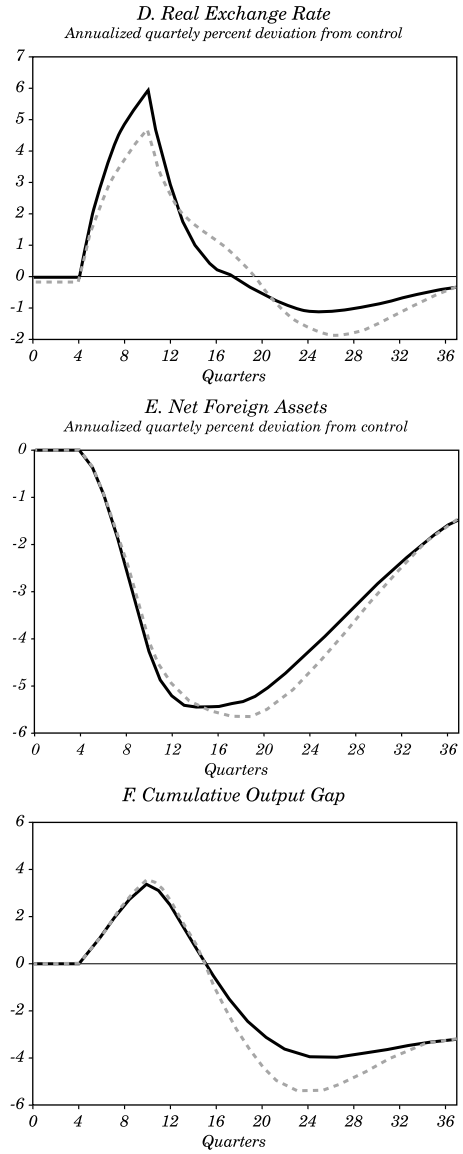


Figure 7. (continued)



Bank underestimates debt appetite and exchange rate shocks (scenario 4)
Outcome with shorter policy horizon (scenario 5)

Source: Author's calculations.

In shortening the policy horizon, the central bank effectively takes more account of the so-called direct channel of the exchange rate, that is, the impact on CPI inflation caused by the effect of the appreciation of the exchange rate on the price level of imported items. Accordingly, monetary policy is initially easier, since the rise in the exchange rate initially leads to lower inflation (see panel B of figure 7). The corollary is that the central bank takes less account of inflationary pressures arising from the slower-acting positive demand shock. When the central bank finally sees 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.

This stylized result sheds some light on what occurred in the mid-1990s. Monetary policy was probably at the greatest risk of operating over an excessively short-term horizon when inflation was very close to the edge of or outside the target range of 0 to 2 percent. This occurred approximately in 1995 and 1996. The Bank was very much under the spotlight during this period, and policy was almost inevitably focused 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 to achieve the goal. In successive quarters, it was projected that within two or three quarters ahead inflation would fall below 2 percent, but that outcome was not achieved until mid-1997.[19]

In hindsight, a possible explanation for the unexpected resilience of inflation during the period mid-1995 to mid-1997 was that the Bank was putting too much weight on the expected direct price benefits of the appreciating exchange rate. The Bank relied primarily on the mark-up approach to projecting inflationary pressures, in which the inflation outlook was based on cost pressures and margins.[20] The exchange rate, through its influence on import prices, was an important driver. Throughout this period, the appreciating exchange rate constrained near-term aggregate inflationary pressures, despite the more persistent inflationary pressures still in the domestic economy. Insufficient attention was initially given to these persistent domestic inflationary pressures, which are most influenced by the longer-term impact of the exchange rate and interest rates on, first, demand and then inflation.

19, See the Reserve Bank of New Zealand's *Monetary Policy Statements* over this period for a detailed account.

20. See Beaumont, Cassino, and Mayes (1994) for an in-depth discussion of this approach to modeling prices.

The use of the MCI in 1997–98

Output growth was negative over the first half of 1998 as the New Zealand economy was negatively affected by three coincident influences: a large swing in net migration, the Asian crisis, and successive droughts throughout large parts of the country.[21] Although these shocks were unavoidable, the question remains whether monetary policy responded appropriately, thereby buffering the shocks, or whether it was unhelpful. This section outlines the Bank's view of the shocks at the time, as well as the interaction of this factor with the MCI implementation regime. The broad lessons from the period are then illustrated via stylized model simulations.

From mid-1997 to year-end 1998, a monetary conditions index (MCI) was used to signal the stance of monetary policy with the release of the Bank's *Monetary Policy Statement* each quarter.[22] In order to maintain the policy stance across quarters, any falls (rises) in the exchange rate were required to be offset by increases (falls) in interest rates.[23] Over late 1997 and early 1998, this did, in fact, lead to rising interest rates, between quarterly resets, as the exchange rate began to trend sharply downwards.

The exchange rate fell through much of 1997 and into 1998, and the Bank initially resisted the extent of the easing in monetary conditions by successively indicating desired levels of monetary conditions that were consistent with interest rates rising. This reflected the fact that the Bank thought growth conditions would be rather stronger than

21. See the paper entitled "Business Cycle Developments and the Role of Monetary Policy over the 1990s" at www.rbnz.govt.nz/monpol/review/index.html for a detailed description of the size and impacts of these shocks on output.

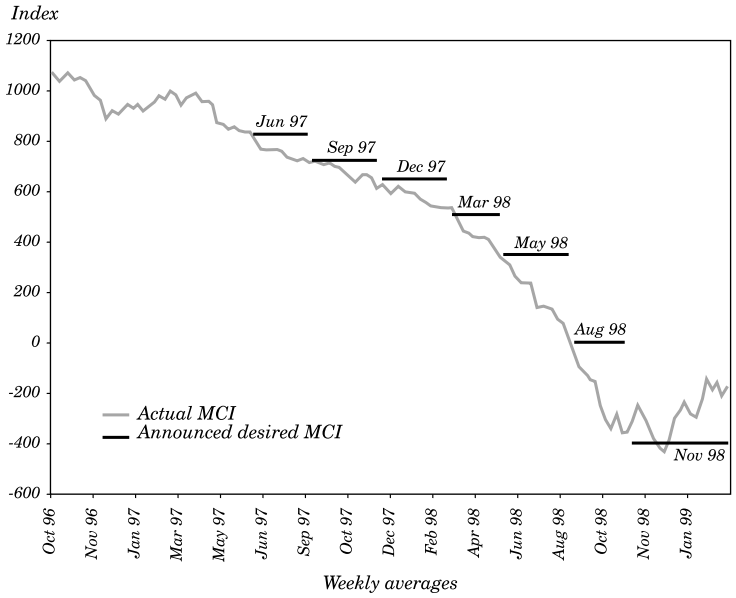
22. See Ball (2002) for a discussion of the use of an MCI as a policy instrument and Hunt (1999) for the macroeconomic implications of using an MCI in FPS under general stochastic disturbances. Also see the paper entitled "The Evolutions of Monetary Policy Implementation" at www.rbnz.govt.nz/monpol/review/index.html for a detailed description of why the Bank moved to use an MCI and then later switched to its current cash-rate system.

23. The official MCI as used by the Bank to implement monetary policy was calculated as:

$$mci_t = [90\text{-}day\ interest\ rate_t - 90\text{-}day\ interest\ rate\ at\ 1996:4 + 50\log(TWI\ exchange\ rate_t / TWI\ exchange\ rate\ at\ 1996:4)].$$

The evolution of the MCI was then relative to a base-period (1996:4). A given percentage change in the nominal ninety-day interest rate was thus given twice the weight of an equivalent-sized change in the TWI exchange rate. For example, if the TWI fell by 1 percent, interest rates would need to rise by 50 basis points to maintain the desired level of monetary conditions, all else equal.

Figure 8. The Monetary Conditions Index and Successive Quarterly Policy Resets



Source: Reserve Bank of New Zealand, *Monetary Policy Statements* and *Economic Projections*.

proved to be the case. It did not anticipate the full magnitude of the Asian crisis or the severity of the first drought. As the extent of the fall in economic activity became more obvious through the first half of 1998, the Bank began to encourage a more rapid easing of desired monetary conditions. This is illustrated in figure 8, which shows the profile of the MCI from late 1996 to early 1999 together with indications of the desired MCI at successive quarterly policy resets. The easing that occurred between mid-1997 and the end of that year were quite small, but they became larger after December 1997.

The Bank's policy stance was also influenced by its understanding of what was behind the fall in the exchange rate. Had it recognized the depreciation as well founded in changing fundamentals, it would have targeted a lower desired level of the MCI and allowed actual conditions to ease more quickly. In addition, at least in late 1997, the Bank lacked a full appreciation of the required cyclical amplitude of monetary conditions in the context of large exchange rate shocks. This meant that the effective magnitude of easing at each quarterly policy reset, in terms of its impact on the real economy, was rather less than expected at the time.

The overall effect on the economy of the initial interest rate rises in early 1998 is uncertain. Although the rises coincided with falls in consumer confidence, residential investment, and private consumption, such rapid transmission of policy would normally be ruled out as being implausible. Transmission times are not always and everywhere the same, however. Given the environment of considerable uncertainly resulting from the Asian crisis, it is possible that the interest rate rises could have contributed to observed falls in consumer confidence. In turn, lower confidence may have fed through to lower consumption and investment quite quickly.

To further illustrate the discussion, figure 9 shows two alternative model scenarios. In both scenarios the starting-point level of the real exchange rate is overvalued, and the model is hit with a sequence of negative shocks emanating from both the domestic and external sectors of a size that roughly corresponds to the falls witnessed in 1997–98. In the first scenario policy is set cognizant of both the shocks and the fact that the exchange rate is overvalued. Consequently, interest rates immediately decline, as seen in panel A of figure 9. In the second scenario, the central bank initially regards the fall in the exchange rate as a portfolio disturbance, and it does not foresee the fall in world and domestic demand. Hence the central bank does not seek to ease conditions as measured by an MCI to any material degree. Interest rates rise to maintain an overall level of monetary conditions. As time passes, however, the central bank updates its view of the world and allows monetary conditions to fall rapidly.[24] Interest rates eventually have to fall further than in scenario 1, since the fall in demand is larger given the initial policy mistake. The difference in the output paths, however, is small relative to the underlying cycle that is set up following the disturbances.

The negative impact of the sharp downturn in migration, the Asian crisis, and the drought were always going to produce a reduction in growth and potentially a recession. Although it is difficult to separate the precise impact on the economy of these factors from that of monetary conditions, the use of the MCI implementation framework probably shaped the evolution of monetary policy during that period in a manner that was, on balance, unhelpful.

Summary

The deterministic simulations described above were designed to highlight some of the ways in which the Bank's monetary policy frame-

24. The central bank sees the full implications of the shocks after one year.

Figure 9. The Implications of Using an MCI to Base Policy When an Exchange Rate Change is not Seen as Reflecting Necessary Adjustment

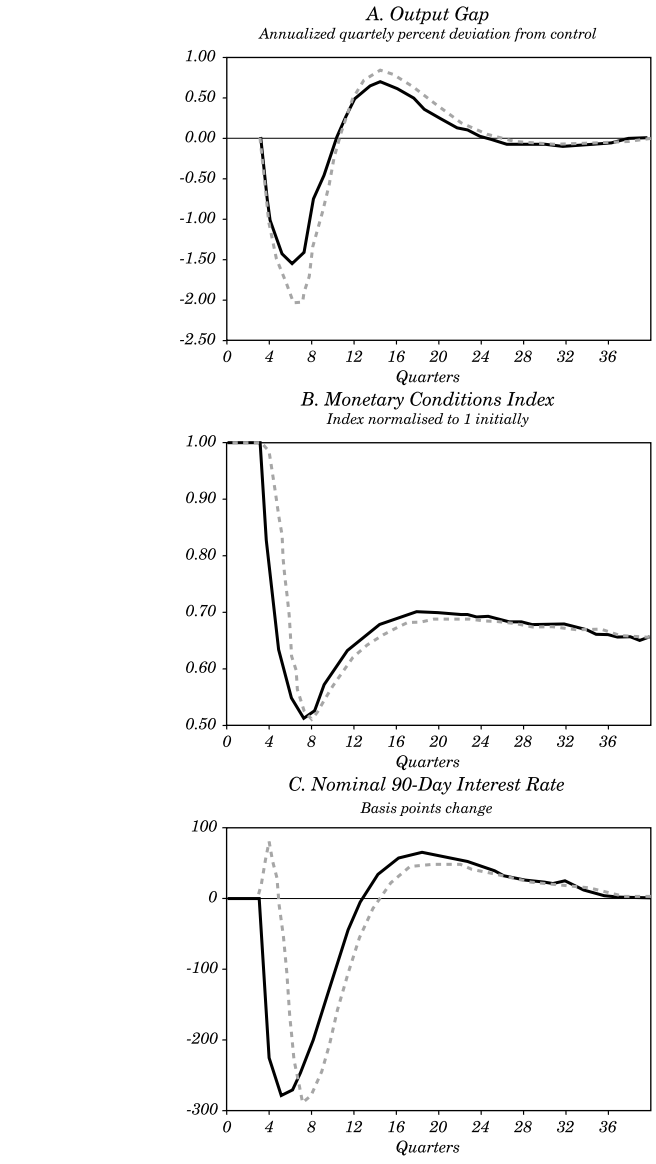
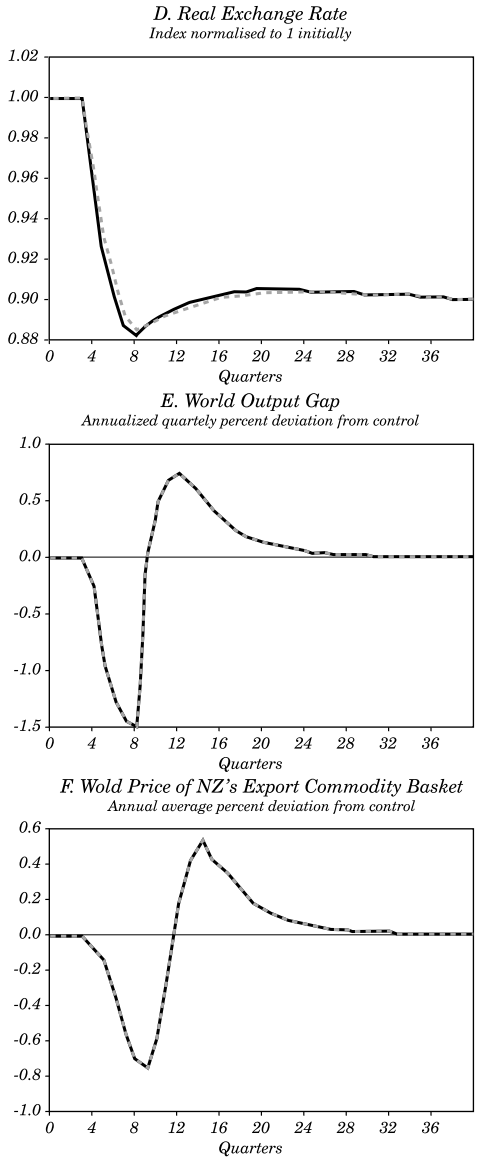


Figure 9. (continued)



Source: Author's calculations.

work interacted with the economic shocks experienced in the 1990s. Given a relatively short policy horizon and a misperception of wealth effects, it became more difficult for monetary policy to maintain price stability in the mid-1990s than might ideally have been possible. In hindsight, reacting sooner to the demand shocks and focussing on the persistent, domestic-based inflationary pressures could have helped moderate the business cycle. Furthermore, had policy eased more quickly in response to the Asian crisis and domestic conditions, and had an MCI not been used to implement policy, the downturn in growth might have been moderated to a significant degree.

The most important feature of the simulations is that the differences between the scenarios are relatively minor in comparison with the cycle triggered by the underlying shocks. This is not to say that monetary policy is unimportant. The simulations do not show what the cycle would have looked like if monetary policy had considerably delayed its reaction to the shocks that occurred or even completely ignored them. The Bank's contention (as indicated by the quote at the start of this section) is that the cycle would have been considerably greater in magnitude than was actually the case.[25] The alternative scenarios presented should therefore be considered more in the nature of refinements to inflation targeting than as different approaches that would have reshaped the events of the 1990s in any fundamental sense.

3.2 Approaches to Inflation Targeting

The scenarios just described illustrate how maintaining low and stable inflation is not incompatible with 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 a permanent increase in output growth, it does have some influence over volatility in the economy.

In part, the volatility issues concern the choice between strict and flexible inflation targeting.[26] The key presumption that must be kept in mind is that the central bank is credible and that inflation expec-

25. Given the structure of the FPS model, this is a fait accompli. Inflation expectations are a linear combination of past outcomes and the model-consistent forward-path solution. Both actual inflation and inflation expectations therefore move away from the target following any disturbance. Monetary policy is required to re-anchor inflation expectations to the inflation target. The longer the policy response is delayed, the larger is both the initial cycle and the secondary cycle required to re-anchor inflation expectations to the target.

26. See Svensson (1997).

tations are relatively well anchored. This certainly was not the situation facing the Reserve Bank of New Zealand when it, like other central banks, embarked on the road to price stability in the mid-1980s. Given the historical circumstances, it took a concerted effort to reduce inflation in the early period of the Bank's inflation-targeting regime. The outcome of this action was that in absolute terms, the variability of both inflation and output was lower in the 1990s than in the 1970s and 1980s. This experience suggests that the variability trade-offs that are depicted in the following sections might be quite misleading during the transition to a low-inflation environment. By reducing the level of inflation, variability in output, inflation, the exchange rate, and real interest rates may all be reduced, as was the case in New Zealand in the 1990s.[27] These improvements may represent the main gains of New Zealand's inflation-targeting regime, and the refinements to the Bank's approach discussed below should be considered in the nature of marginal improvements.

Strict versus flexible inflation targeting

A strict central bank can be categorized as being concerned only with deviations of inflation from some target level. The strict central bank will therefore aim to return inflation to its target in the shortest possible time. It is likely to be most reactive in its interest rate response to inflationary pressures projected as close as, say, two to four quarters ahead. In an open economy like New Zealand, a strict central bank would rely heavily on the direct impact of the exchange rate on consumer prices, given its immediate and transparent impact.

In contrast, a flexible central bank attaches some importance to minimizing 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 considerable weight on the indirect impact of the exchange rate (and interest rates) on prices.[28]

27. The macroeconomic outcomes seen in New Zealand in this regard are not unique. In many countries, inflation and output variability was considerably lower in the 1990s than in the 1970s and 1980s. Although there are certainly other factors behind the more benign economic environment of the 1990s, it is very likely that this occurred in part because of the concerted efforts that central banks took to get inflation down over the mid- to late 1980s.

28. See Svensson (2000).

The Reserve Bank of New Zealand has recognized this sort of trade-off from the outset of its inflation-targeting regime. This recognition is implicit, for example, in the caveats outlined in the successive Policy Targets Agreements and in the phased approach the Bank took in achieving low inflation.[29] More explicitly, the original target date for achieving price stability was extended, following the 1990 election, from year-end 1992 to year-end 1993 on account of the short-run output trade-off.

The decline in and anchoring of inflation expectations achieved in more recent years, in combination with the wider inflation target range established in 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 whether it is possible to reduce the volatility of interest rates, the exchange rate, and output without unduly increasing the volatility of inflation.

This section addresses the volatility questions using stochastic simulations of the model. The randomly drawn shocks in this exercise affect 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 autocorrelations in the data and cross-correlations between the variables. For example, shocks to foreign demand or the terms of trade will affect the exchange rate, as well. A combination of shocks, taken from New Zealand's historical experience, is selected randomly to produce one hundred simulations each quarter, running one hundred quarters into the future (generating 10,000 observations for each variable of interest).[30]

For each alternative monetary policy rule considered, the variability of inflation, output, the exchange rate, and interest rates is calculated over the full twenty-five-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.[31]

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 inflationary pressures—was chosen to reflect both views within the Bank and the findings of wider research. This research

29. See Archer and Nicholl (1992).

30. See Drew and Hunt (1998b) for technical details.

31. See Drew and Hunt (2000) for a discussion on alternative monetary policy rules using FPS.

suggests that the lag between monetary policy actions and inflation outcomes is between one and a half and two years time. The standard monetary policy reaction function is thus set so that policy responds to projected inflationary pressures about six to eight quarters ahead.

Figure 10 plots the results from simulating FPS with the same battery of shocks, but alternative policy reaction horizons. The top panel plots outcomes in terms of output and inflation volatility under different reaction horizons, while the bottom panel shows the policy instrument (interest rate) and inflation volatility. Point 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.[32] Point C is the standard FPS policy rule, and point D is the most forward-looking policy rule considered. It is 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. As the policy horizon is extended beyond six to eight quarters (point C), however, not much is gained in terms of reduced output and instrument volatility, while inflation volatility increases quite markedly. This indicates an optimal policy horizon in the vicinity of point C.

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 six to eight quarters, but 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. In this sense, the results provide some independent support for a reasonably forward-looking policy reaction function.[33]

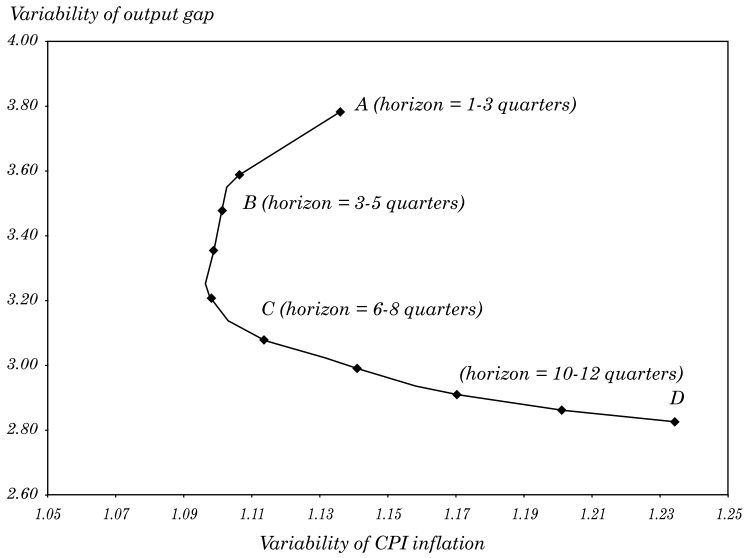
The width of the inflation target band

The final question considered is the degree of flexibility that the current 0 to 3 percent inflation target range brings to policy, compared to the previous target range of 0 to 2 percent. It could be argued that a

32. The policy rule represented by point A fares poorly because the monetary authority tries to return inflation to the target over a horizon in which inflation outcomes are essentially predetermined, given the short-run rigidities that exist in the economy. The monetary authority therefore induces instability in the model economy.

33. For a theoretical discussion on the benefits of using policy rules based on forward-looking inflation forecasts, see Batini and Haldane (1999).

Figure 10. The Implications of Varying the Policy Horizon



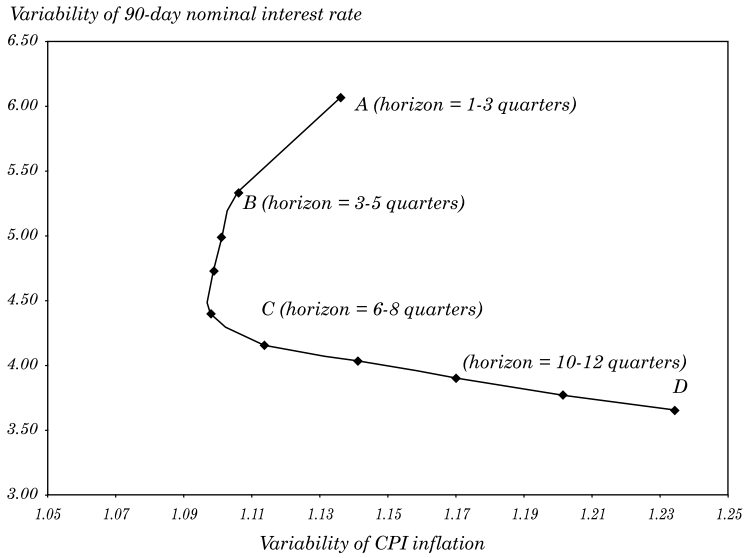


Table 2. Alternative Band Widths for CPI Inflation Targeting Rules

	Less active rule	*Standard policy rule*	*Active policy rule*	*Very active policy rule*
RMSD[a] CPI inflation	1.56	1.13	0.94	0.86
RMSD[a] output gap	3.06	3.07	3.24	3.58
RMSD nominal 90-day interest rate	3.31	4.08	5.51	7.65
Band Width (percent)	*Probability that inflation lies within the given band width (percent)*			
±1.0	50.0	64.0	70.0	75.0
±1.5	66.0	82.0	90.0	92.0
±2.0	80.0	93.0	97.0	98.0
±3.0	95.0	99.0	99.8	99.994

Source: Author's calculations.
a. Root-mean-square deviation.

wider target range allows the Bank to be less active in its policy, since the Bank is able to give projected inflation more time to return to its mid-point. A wider band affords this type of flexibility because it is less likely that the target will be breached.

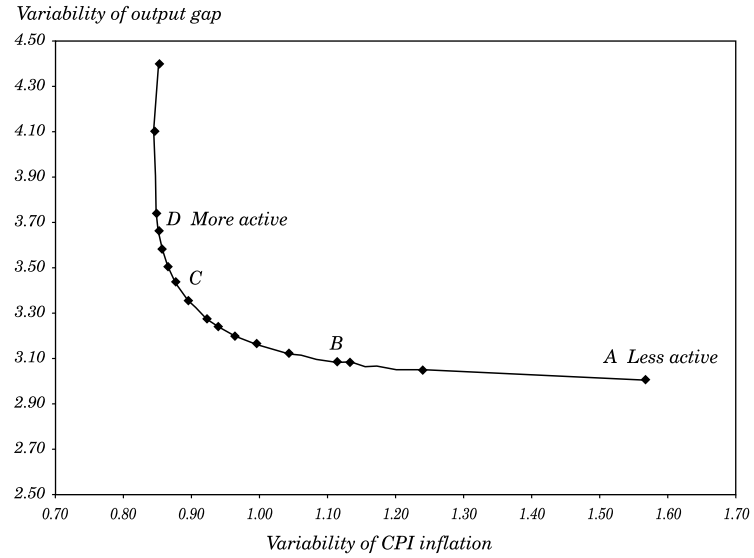
Figure 11 presents the results of further FPS stochastic simulations, this time altering the degree of policy activism. Monetary policy is made more active in the model's reaction function by increasing the size of the interest rate response to any deviations from the inflation target. Conversely, policy is made less active by decreasing the interest rate response coefficient.[34] The top panel of figure 11 demonstrates that the more active the policy response, the lower is inflation variability and the higher is output variability. This illustrates the well-known trade-off between inflation and output variability.[35] The bottom panel illustrates that as the variability of inflation is reduced, instrument variability increases. In the figure, point B represents the standard FPS policy rule. The cost of reducing inflation variability through increased policy activism is a rise in output and instrument variability.

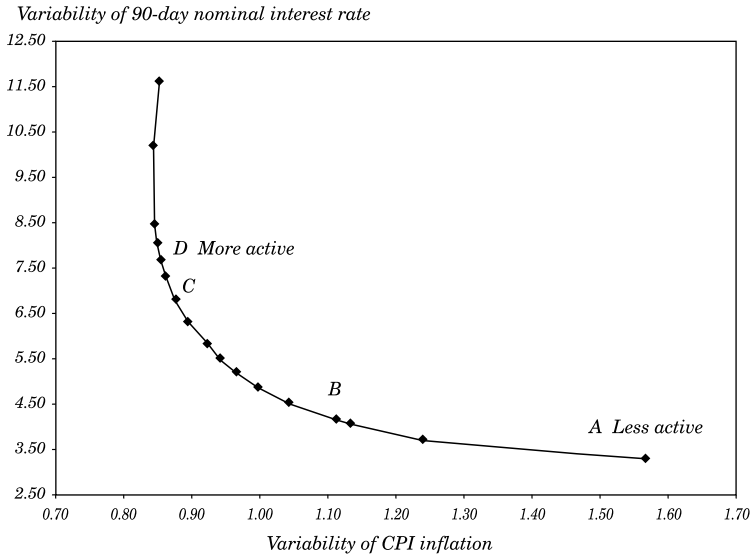
The probability that inflation will fall within a certain range around the target can also be calculated using these results (see table 2).

34. For 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. Point A is a less active policy rule, while points C and D are rules that respond more vigorously to inflation deviations.

35. See Taylor (1994).

Figure 11. The Implications of Varying Policy Activism





Under the standard policy rule, inflation is expected to remain within our current target of ±1.5 percentage points around the mid-point about 80 percent of the time. In contrast, the less active policy rule keeps inflation within the range 66 percent of the time, while the more vigorous policy rules ensure inflation remains within the band over 90 percent 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 favor a more active policy approach. Similarly, if the Bank is trying to establish credibility by achieving its inflation target at all times, then it is wise to favor 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—recognized that although the Bank should constantly aim 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, the Bank shifted toward a longer-term horizon for 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 should be interpreted as stylized results, rather than as strict quantitative assessments of, for example, the optimal inflation target range or the optimal policy horizon. 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.

4. Conclusions

This paper has discussed some monetary policy issues that emerged from the Bank's reviews of the conduct of monetary policy in the 1990s. 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 is 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 comprise 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, among other things, the longer horizon over which inflation is targeted and increased focus on the key demand pressures in 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 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 recognizes that while monetary policy cannot be used to engineer sustainable faster growth in the long term, there is a trade-off between the variability of the policy instrument and output, on the one hand, and the variability of inflation, on the other.

The most significant lesson for the Bank, however, is the importance of preempting shifts in inflationary pressures. If monetary policy is able to adjust in a timely manner, then a considerable degree of interest rate, exchange rate, and output volatility may be avoided. At the end of the day, this requires that the right decisions are made when required. Given the uncertainty surrounding policymaking, this is not an easy task. I close with a quote from the Bank's submission to the *Independent Review of Monetary Policy:*[36]

> The Bank has to continually balance the risks of doing "too little too late", and possibly unnecessarily accentuating the business cycle, against the possibility of over-reacting to inflationary pressures, thereby also causing unnecessary volatility in the economy. This is often difficult, as signals from the data can be unclear or conflicting. The art of policy-making is to get a good feel for the pulse of the economy. This involves making judgements about the relative value of information in various data sets. It also involves continuously updating one's view or "model" of how the economy works. Such judgements are made on the basis of historical experience, research, intuition, and by keeping in touch with people in New Zealand engaged in a wide variety of economic activity, as well as in various institutions at home and abroad.

36. See the paper entitled "Inflation Targeting in Principle and Practice."

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