MONETARY POLICY CREDIBILITY AND PRICE UNCERTAINTY: THE NEW ZEALAND EXPERIENCE OF INFLATION TARGETING

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INTRODUCTION

A reduction in the uncertainty faced by consumers and producers is a desirable outcome of an economic stabilisation policy. Since both expectations and actual economic outcomes depend on policy, it is possible that a stable monetary policy – such as credible inflation targets – will reduce price uncertainty. Since 1989 the monetary authorities of five OECD countries have announced inflation targets as their specific monetary policy goal. The countries include New Zealand (1990), Canada (1991), the United Kingdom (1992), and Sweden and Finland (1993). The inflation targeting approach has been adopted following either a decline in the effectiveness of previous money growth focus in controlling inflation (as in Canada and New Zealand), or the removal of an existing policy anchor, *i.e.* pegged exchange rates, following the European exchange market turmoil of 1992 and 1993 (in Sweden, the United Kingdom and Finland). The broad aim of inflation targets is to create a nominal anchor for monetary policy, which provides sufficient evidence of the central bank's commitment to price stability – against which the public can assess their performance – without being bound to any single operational rule. The inflation targets are generally established with reference to annual consumer price inflation,' although in all countries the first-round effects of certain price shocks are accommodated.' In the case of New Zealand, the central bank's commitment to price stability is further underpinned by the implementation of legislation which specifies a single objective for monetary policy – the maintenance of price stability.

Given both New Zealand's longer history of inflation targeting and the existence of a legislative framework to ensure that priority is given to price stability, this country's recent experience is used to test the proposition that price uncertainty is reduced by a stable policy. This includes the implementation of the Reserve Bank Act – which provided the central bank with greater independence in policy formation and a single objective of price stability – as well as, the announcement of specific inflation targets in the Policy Targets Agreement. In addition to these influences, the relative importance of other sources of price-related uncertainty are assessed, including the past time-series behaviour of actual inflation, business cycle and political influences, and the role of uncertainty regarding the current and future stance of monetary policy. This latter variable is relevant because the inflation targets, though providing a nominal anchor, do not imply a strict operational rule for monetary policy. Instead, the Reserve Bank of

New Zealand (RBNZ) has maintained a checklist approach to policy setting, potentially reducing the transparency of policy actions and leading to price uncertainty.

The empirical analysis uses survey data gathered by the RBNZ during a period of significant policy change. The RBNZ survey covers a wide range of macroeconomic variables, including several variables that are related to future price uncertainty, allowing a cross-section framework to be utilised. Such an approach is warranted given the interactions which may exist between price uncertainty itself and other nominal variables, most notably interest rates. Hence, the variables used in the cross-section estimates include inflation expectations, as well as short and long-term interest rate expectations.

The paper is organised as follows: after a short discussion of the rationale for inflation targets, a brief overview of the New Zealand experience is provided to clarify the choice of the variables used in the analysis. Some potential sources of price uncertainty are then identified, as well as some reasons as to why this uncertainty may differ under rule-based as opposed to discretionary policy regimes. This is followed by a description of the data and empirical tests, with special attention given to the inflation target variables and to recent legislative changes related to central bank independence. The empirical analysis presents results from the cross-section analysis, enabling some broad conclusions to be drawn concerning the influence of inflation targets on price uncertainty.

I. THE RATIONALE FOR INFLATION TARGETING

Disinflation is more costly to achieve when the public lacks confidence in the central bank's willingness or ability to carry out a newly announced policy. Although the implementation of a rule-based policy may resolve some of the time-inconsistency problems of operating monetary policy (as discussed by Barro and Gordon, 1983)[3] other credibility concerns can still arise. These concerns may make it desirable for the government and central bank to announce publicly their commitment to a clearly specified target path of inflation. For example, an announced inflation target, with specified dates for its achievement, can resolve the problem of incomplete or asymmetric information regarding policy intentions. Inflation targets assure that the public are aware of the speed at which the central bank is attempting to disinflate and are provided with a benchmark against which they can assess the central bank's performance. Such targets can also be informative concerning the type of inflationary shocks which policy may be willing to offset, adding to the transparency, and perhaps credibility, of monetary policy. Finally, they provide a clear agreement between policy makers, thereby limiting

the scope for discretionary policy actions. Walsh (1992) and Perrson and Tabellini (1992), for example, view the announcement of inflation targets as a contract between the government and the central bank, which enables the government to achieve its objectives by altering the incentive structure of the central bank's management.

II. INFLATION TARGETING IN NEW ZEALAND

As noted earlier, several countries within the OECD now operate inflation targets, although none of these countries have gone as far as New Zealand in terms of legislative support. Indeed, in all other countries the targets generally represent informal joint statements between the government – who often decides the stance of monetary policy – and the central bank – who is charged with implementing the policy. This leaves the achievement of, and commitment to, price stability in the hands of the incumbent government and potentially subject to other short-term political goals. By contrast, important legislative changes have altered the framework for New Zealand monetary policy. The 1989 Reserve Bank of New Zealand Act declared price stability the only goal of monetary policy. The Act was introduced to give the Reserve Bank greater independence, while also ensuring that it is accountable for achieving its objective and that its operations are more transparent to the public. The Act mandates the RBNZ Governor and the Minister of Finance to agree on a definition of price stability and to announce the result publicly in the Policy Target Agreement (PTA).
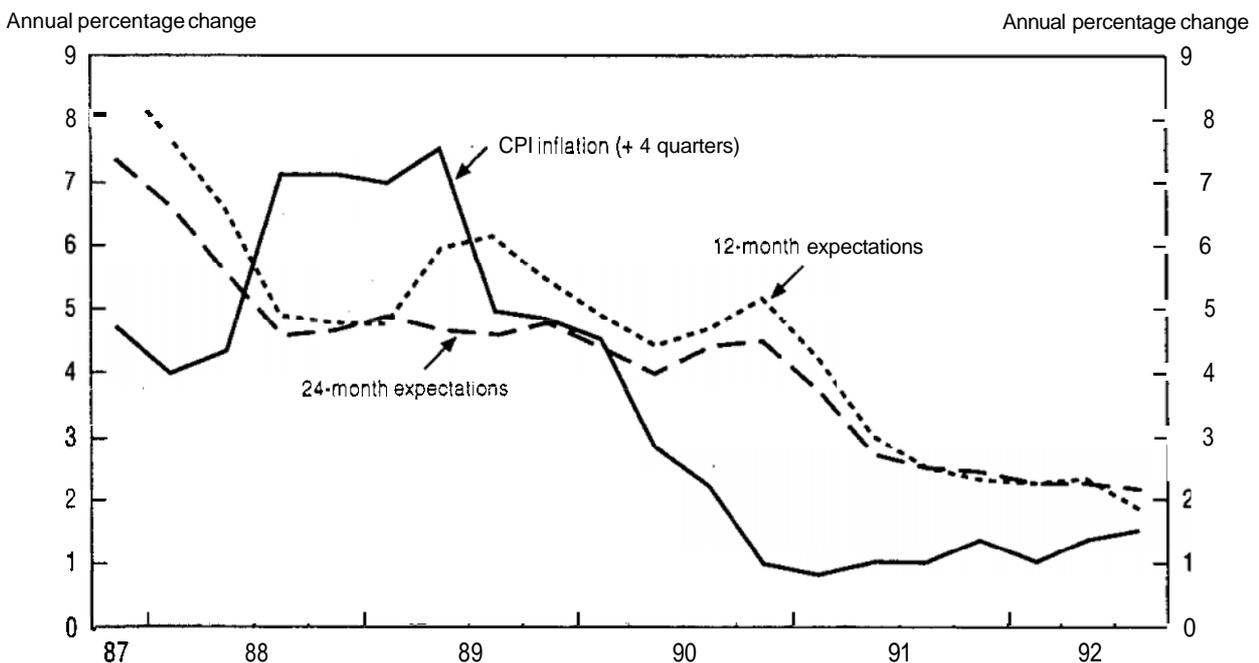
The initial PTA (announced in early 1990) specified that monetary policy is to be directed towards achieving a year-over-year consumer price inflation rate of 0 to 2 per cent by December 1993. This time frame was extended by one year in December 1990, following a change in government. In February 1991, the Reserve Bank announced its own interim target ranges for inflation of 2.5 to 4.5 per cent by December 1991 and 1.5 to 3.5 per cent by December 1992.[4] In a second PTA agreement signed in December 1992, price stability was redefined as a moving average target of 0 to 2 per cent (annualised) CPI inflation.

Several features of the PTAs are noteworthy, as discussed in Fischer (1993). First, the short time frame for disinflation in the original PTA suggests that the strategy placed a strong emphasis on achieving price stability, in an effort to establish credibility,[5] despite the potential risk of creating an unbalanced mix between monetary and fiscal policy. Second, the PTAs defined the objectives of monetary policy clearly and guaranteed a high degree of central bank independence with regard to the formulation and implementation of policies to achieve these objectives. This was a change from previous practice, where the Ministry of

Finance played an active role in determining the conduct of monetary policy on a day-to-day basis.[6] Third, the inflation targets offered greater policy accountability. For example, although the price stability targets allow for temporary deviations should indirect taxes increase, or a terms-of-trade shock or natural disaster occur, the Reserve Bank must immediately detail how it intends to ensure that the effect on prices is only transitory. On a more regular basis, the Governor of the Reserve Bank must also publicly clarify the Bank's past and future actions. It is these biannual reports which provide valuable information regarding the Bank's assessment of the future path of the real and nominal economy and, subsequently, its views on future inflation.

Inflation, which had averaged above 10 per cent in the 1970s and 1980s, has come down quickly since the implementation of the first PTA (see Figure 1). Indeed, the RBNZ undershot its intermediate targets, with actual annual inflation measuring 1 per cent through 1991 and 1.3 per cent through 1992. However, given that a large contribution of the disinflation process arose from the widening output gap during this period, the gains from the inflation targeting strategy alone are difficult to assess. Furthermore, the level of inflation expectations remained above actual inflation throughout the period of the Act being in place, with this gap narrowing markedly only more recently. It therefore is necessary to account for

Figure 1. Inflation: actual and expected

Annual percentage change

CPI inflation (+ 4 quarters)

12-month expectations

24-month expectations

Source: New Zealand Department of Statistics and Reserve Bank of New Zealand

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unforeseen business cycle developments when assessing the relative merits of inflation targets.

Even though the RBNZ's operating procedures have remained a checklist approach — monitoring several leading indicators with no explicit intermediate target —[7] the announcement of inflation targets provides a nominal anchor and the anti-inflation legislation accompanying these targets ensures a more transparent and stable policy environment. The combination of this experience with new survey data on inflation expectations provides an opportunity to assess the impact of the use of inflation targets and enhanced central bank independence on price uncertainty.

III. POTENTIAL SOURCES OF PRICE UNCERTAINTY

As a means of identifying potential determinants of price-related economic uncertainty for empirical analysis, this paper utilises the theoretical framework described in Batchelor and Orr (1991).[8] The latter provides several empirically testable propositions as to why individual differences in inflation expectations may arise, and what may be the influence on price uncertainty of changes in the degree of confidence with which these expectations are held. The resulting empirical framework is a series of statistical hypothesis tests, rather than detailed modelling of some behavioural theory. In brief, the framework is based on the assumption that individual i forms expectations at time t of price changes conditional on: observed price changes in the market in which individual i trades (p_{it}), past rates of general inflation p_{t-1}, p_{t-2}, ..., etc; and the government's current target for inflation π_t.[9] Individual price changes (p_{it}) and the general rate of inflation (p_t) are assumed to be related as:

$$p_{it} = p_t + \acute{e}_{it} \qquad [1]$$

$$p_t = \begin{cases} \pi_t, & \text{with probability } \alpha_t \\ \phi_t + \upsilon_t, & \text{with probability } (7 - \alpha_t) \end{cases} \qquad [2]$$

Here, ϕ_t is the systematic component of inflation under unchanged policies,[10] while the credibility (α_t) of the inflation targets is the probability that the target π_t will be achieved. That is, α_t can be viewed as a credibility index of the central bank's inflation target. The target (π_t) and the systematic component (ϕ_t) represent two types of price-expectation formation: the former is forward-looking with respect to a stated policy intention, while the latter is adaptive or backward-looking based on past inflation outcomes.

The independent shocks to price changes for individual i and the general rate of inflation are denoted respectively as:

$$\acute{e}_{it} \sim N(0, \rho_t^2)$$ [3]

$$\upsilon_t \sim N(0, \sigma_t^2)$$ [4]

where ρ_t^2 is the variance of relative prices across markets, and σ_t^2 is the variability of general prices over time.

Using observations on p_{it}, π_t and $(l_t$, an individual can form a subjective probability distribution for the general rate of inflation p_t which takes the form:

$$\mu_{it} \sim N(p_t, \tau_t^2)$$ [5]

In this analysis it is assumed that all individuals are equally well informed and trusting of government policy, implying that the degree of uncertainty about inflation is the same for all individuals. This allows the subjective variance of inflation expectations (τ_t^2) to be treated as a proxy measure of price uncertainty. τ_t^2 can be shown to be a function of:

$$\tau_t^2 = f(\overset{+}{\rho_t^2}, \overset{+}{\sigma_t^2}, \overset{+}{|\phi_t - \pi_t|}, \overset{+/-}{\alpha_t}, \overset{0}{\tau_{t-1}^2})$$ [6]

That is, subjective price uncertainty depends positively on the variance of relative prices across markets p_t^2, positively on the variability of general prices over time σ_t^2, and positively on the gap between the systematic component and targeted inflation $|\phi_t - \pi_t|$.

However, within this framework subjective price uncertainty is also shown to be dependent on the degree of policy credibility (α_t), although its correlation with subjective uncertainty cannot be determined a priori, depending on the initial level of policy credibility and the past behaviour of actual prices. For example, Batchelor and Orr (1991) demonstrate that when $\alpha_t = 7$, a stated policy intention is fully credible and subjective uncertainty is reduced to zero. Conversely, when $\alpha_t = 0$, the stated policy lacks any credibility and price uncertainty remains determined solely by the variability in relative prices and the volatility of general prices. Subjective uncertainty reaches its maximum when initial credibility is either low or zero. In sum, an increase in policy credibility is most likely to lower subjective uncertainty when either initial policy credibility is high, or the volatility in past inflation is high, or the gap between historical and target inflation is small.

In the context of New Zealand, a rise in policy credibility alone – as a result of the enhanced central bank independence and announced inflation targets – is not sufficient to guarantee a decline in subjective uncertainty. Indeed, if for example initial policy credibility was low, the inflation targets themselves could prove a further source of uncertainty, as individuals remain unsure whether they will actually be pursued. The correlation between α_t and τ_t^2 thus remains open to empirical analysis and is tested in the following section.

Lastly, a significant term β in the first-order equation for uncertainty $\tau_t^2 = \beta\tau_{t-1}^2 + \acute{u}_t$ would imply that price uncertainty follows an adaptive or random behaviour, possibly reducing the explanatory significance of other variables in Equation [6]. The influence of lagged price uncertainty will also be tested formally in section **V.**

IV. EMPIRICAL MODEL AND DATA PARAMETERS

Since June **1987** the RBNZ has been conducting a survey of ten different macroeconomic variables on a quarterly basis,[11] with the majority of the respondents from the financial and business sectors. Questions and responses from the RBNZ Survey are published in the *Reserve Bank Bulletin,* with details of the survey available in an appendix to this paper. Following Cukierman and Wachtel (**1979**), price uncertainty is measured by the standard deviation of the directly observed price-related expectations drawn from the RBNZ Survey.

A. Empirical model

The empirical analysis and hypothesis testing is based on the influences in [6] and from the alternative political influences considered in Section II. The data used in the empirical model are quarterly and span the period **1987:** 3 to **1992: 3. A** cross-section framework is used to assess individuals' forecast performance for a range of economic variables related to price uncertainty. These variables include inflation expectations themselves, as well as both short and long-term interest rate expectations − providing 60 observations in total. The model is defined in [7], with a general dynamic specification (with $k = 2$ lags for all variables excluding the dummy variables) chosen at the outset given the few insights theory provides regarding the lags involved in information acquisition and expectations formation (see box for a full list of variable definitions).

$$ESD_{jt} = \beta_0 + \beta_{j0} + \beta_{1k}(L)ESD_{jt-k-1} + \beta_{2k}(L)TAR_{t-k} + \beta_3 LEG_t$$
$$+ \beta_{4k}(L)MON_{t-k-1} + \beta_5 POL_t + \beta_{6k}(L)INFL_{t-k} + \beta_{7k}(L)MSD_{t-k}$$
$$+ \beta_{8k}(L)SDRP_{t-k} + \beta_{9k}(L)GAP_{t-k} \tag{7}$$

for variables $j = (1, ..., 3)$

ESD_{jt} is a proxy for price uncertainty and is a stacked vector including the survey variables CPI inflation, and short and long-term interest rates.[12] In all cases, two forecast horizons are used: the end of "current" quarter and twelve-month "expectations". Figures **[2]** to **[4]** display the time paths of the actual
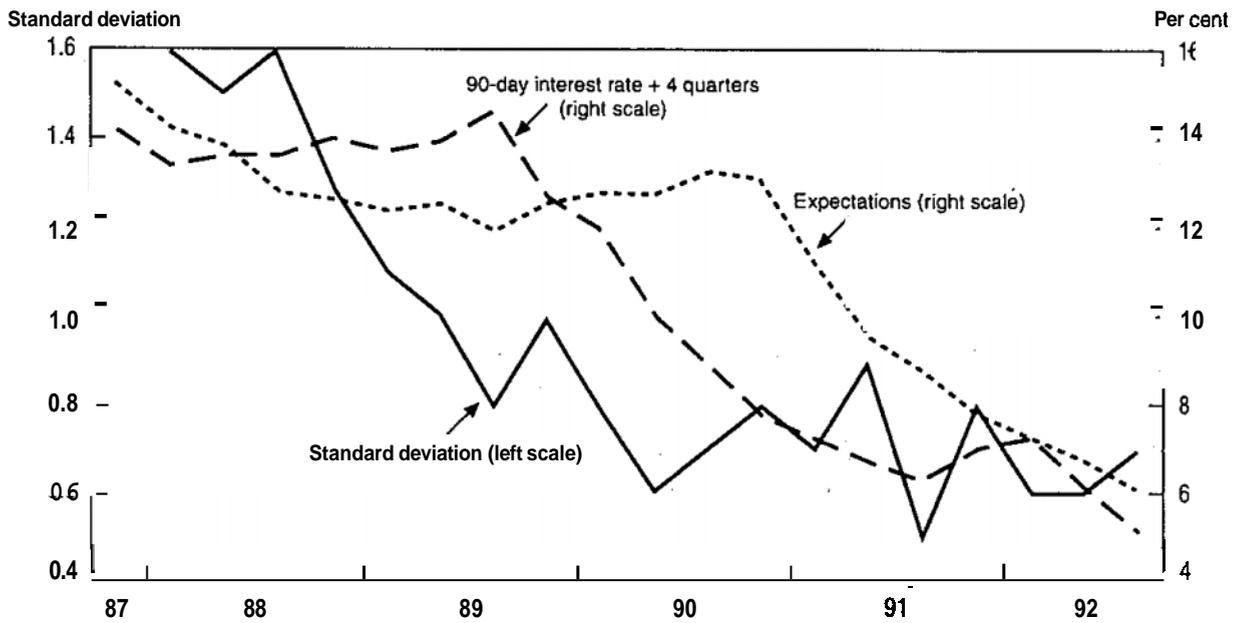
Box 1: Variable definitions

The definitions of the variables in [7] are as follows:

ESD_{jt} — the standard deviation around the mean expectation of the price-related RBNZ survey variables, including expectations of inflation and short and long-term interest rates.

$TAR12_t$ and $TAR24_t$ — respectively the absolute difference between the RBNZ's forecast of annual consumer price (CPI) inflation and the 12 and 24-months ahead actual inflation outcome.

LEG_t — a vector of two dummy variables including:

$RBACT_t$ — zero prior to the implementation of the Reserve Bank Act and +1 from the second quarter of 1990.

PTA_t — zero prior to the confirmation of the RBNZ's target ranges for inflation and +1 from the first quarter of 1991.

MON_t — the variance across individuals' perceptions of monetary conditions from the RBNZ survey.

POL_t — a vector of two dummy variables:

$PARTY_t$ — zero when the Labour Party was in government and +1 when National gained power in the fourth quarter of 1990.

$ELECT_t$ — an impulse dummy variable, being +1 in the quarter of the October 1990 election, −1 in the quarter after, and zero otherwise.

$INFL_t$ — the annual year-on-year rate of consumer price (CPI) inflation.

MSD_t — a proxy of the variability of inflation (σ_t^2), measured as a moving standard deviation of year-on-year inflation over the eight quarters preceding time t.

$SDRP_t$ — a proxy for the dispersion of prices across markets (ρ_t^2), measured as a weighted standard deviation of inflation over the previous year across the five main product groups in the consumer price index.

GAP_t — a proxy for the output gap, measured both by the rate of unemployment and an index of capacity utilisation from the New Zealand Institute of Economic Research.
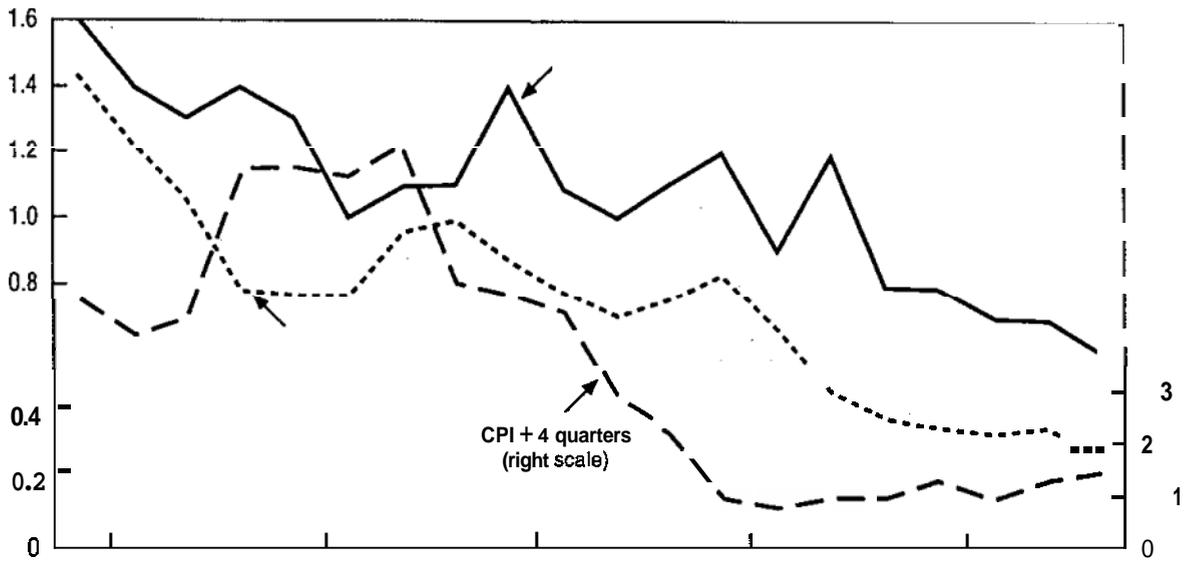
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1.6
1.4
1.2
1.0
0.8

0.4

CPI + 4 quarters
(right scale)

0.2

0

3

2

1

0

**Figure 3.   Short-term interest rates, expectations and uncertainty
12 month-horizon**

Standard deviation

Per cent

1.6

1.4

1.2

1.0

0.8

0.6

0.4

90-day interest rate + 4 quarters
(right scale)

Expectations (right scale)

Standard deviation (left scale)

1€

14

12

10

8

6

4

87   88   89   90   91   92

Figure 4. **Long-term interest rates, expectations and uncertainty**
12-month horizon

Standard deviation   Per cent

5-year interest rate + 4 quarters
(right scale)

Expectations
(right scale)

Standard deviation
(left scale)
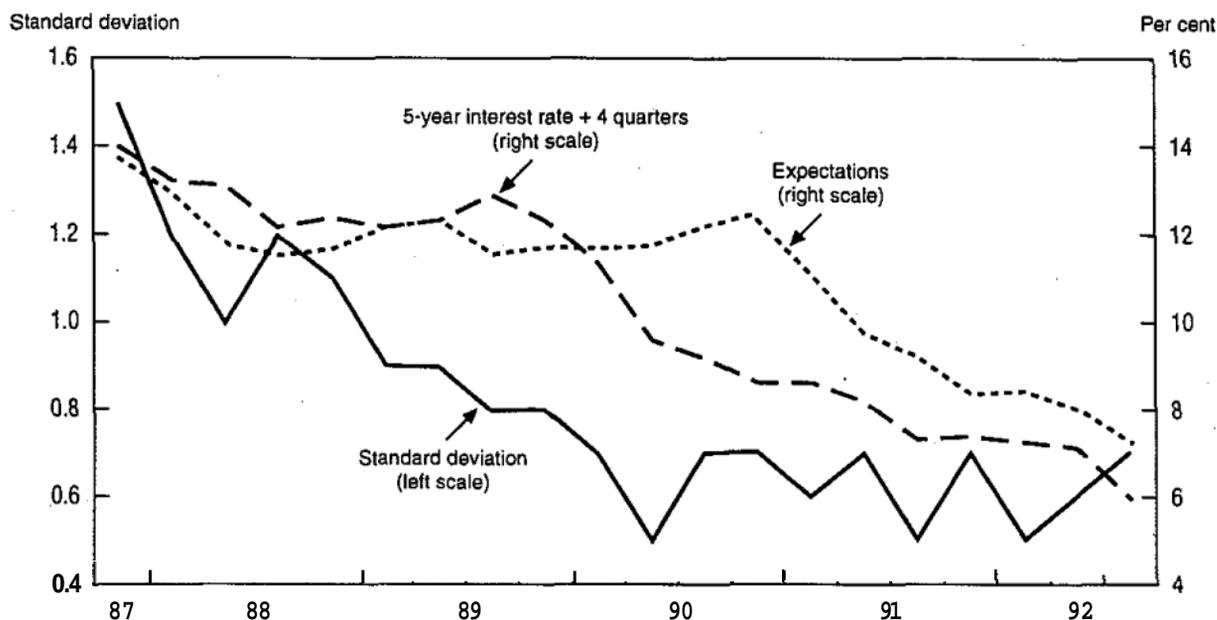
*Source:* New Zealand Department of Statistics and Reserve Bank of New Zealand.

variables being forecast, the mean expectations from the survey, and the standard deviation around this mean ▬ our proxy of uncertainty. In all cases the standard deviations appear to be related to the level of both the actual variables and the mean expectation. However, the uncertainty proxies are more volatile than the level of the mean expectations, suggesting other influences may be important in explaining price uncertainty.

Figures [5] and [6] indicate that the degree of uncertainty surrounding the three forecast variables is of similar magnitude and broadly correlated, especially in the case of twelve-month expectations. This suggests that similar influences may determine the level of uncertainty in all three variables, thereby justifying the use of a cross-section framework.[13]

$TAR12_t$ and $TAR24_t$ are respectively the absolute difference between the Reserve Bank's forecast of annual CPI inflation, 12 and 24-months ahead, and current actual inflation. The inflation forecasts are those published in the *Reserve Bank of New Zealand Forecasts*.[14] These have an elevated role in policy formation following the introduction of the inflation targets. The forecasts provide the public with the RBNZ's view on the future time path of real and nominal economic variables which are consistent with the achievement of the official inflation objective. In a sense, these forecasts have gradually become a form of policy rule for the operation of monetary policy (see Grimes and Wong, 1992).

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Figure 5. Price-related uncertainty
12-month horizon

Standard deviation

Standard deviation
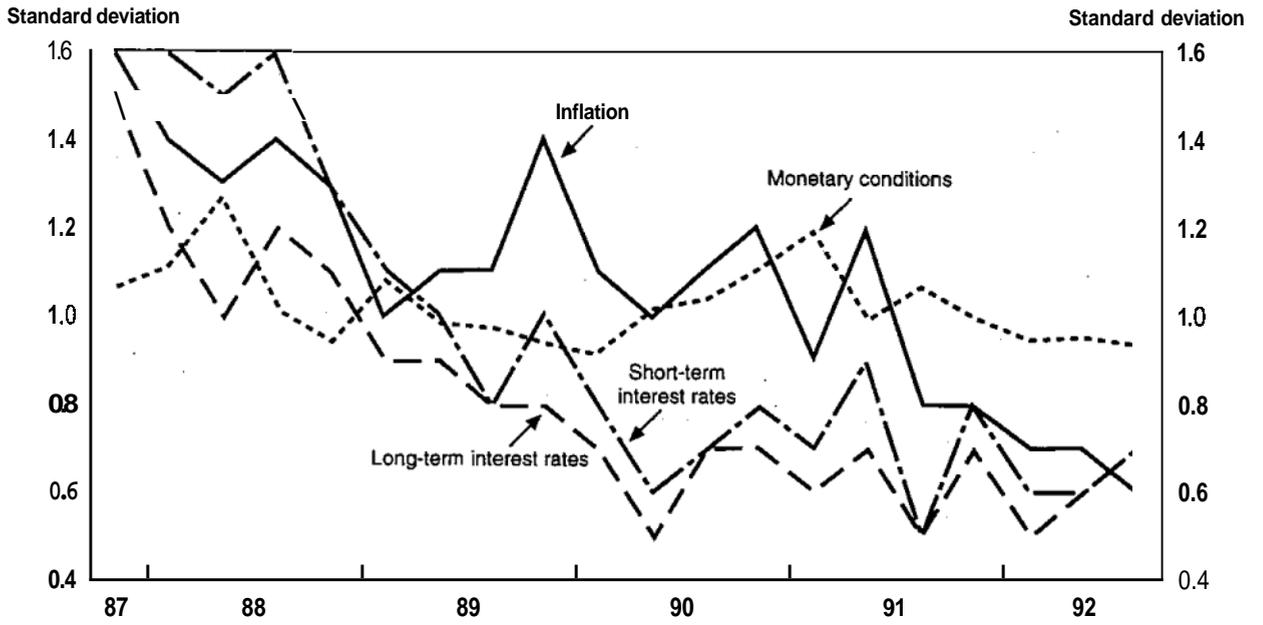
Source: Reserve Bank of New Zealand.

Figure 6. Price-related uncertainty
Current horizon

Standard deviation

Standard deviation
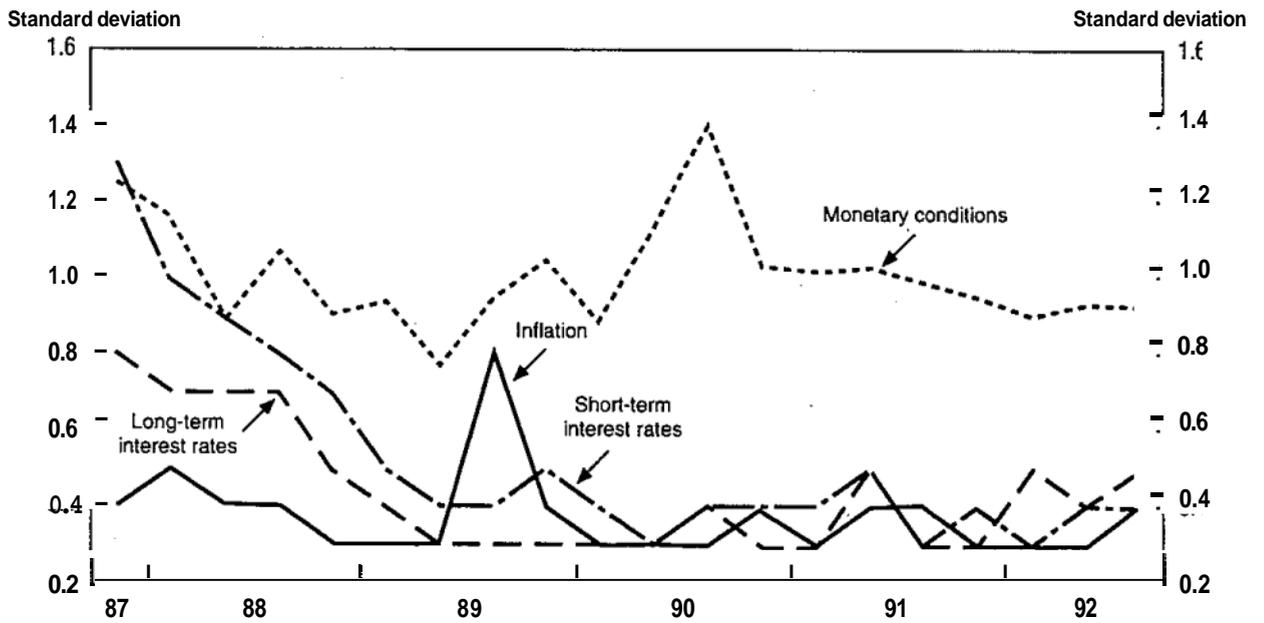
Source: Reserve Bank of New Zealand.

LEG_t is a vector of two dummy variables designed to capture the influences of anti-inflation legislation on uncertainty, thus acting as a proxy for policy credibility (α_t). The first is the Reserve Bank Act (*RBACT_t*), which defined price stability as the chief goal of monetary policy and enhanced the Reserve Bank of New Zealand's independence. The second variable, (*PTA_t*), depicts the announcement of the interim inflation targets by the RBNZ under the Policy Targets Agreement.

MON_t is the variance across individuals' perceptions of monetary conditions from the RBNZ's survey. The survey questions respondents about their perceptions of the present and future stance of monetary policy. The responses can take values ranging from 1 (very tight) to 7 (very loose). Two periods are defined; current (*MCP_t*) and the next 12 months (*MC12_t*). Due to the endogeneity of the expectations, *MON_t* is introduced with a one quarter lag (see Figures 5 and 6).

POL_t is a vector of dummy variables designed to capture the influence of political influences on inflation. The first is the party variable *(PARTY,)*, designed to assess whether the Labour and the National governments are perceived to have different preferences between inflation and other policy objectives. Several variations of an impulse dummy were also introduced in an effort to identify election influences on economic uncertainty. Such a variable may appear signficiant if, for example, some individuals perceive the incumbent government to become growth oriented in the run-up to an election, ignoring any inflationary consequences until after. The most significant election dummy *ELECT,* presented in the results takes the value +1 in the quarter of the October 1990 election, −1 after the election quarter, and is zero otherwise.

Finally, *GAP,* is a proxy for the output gap. The inclusion of the gap variable is to assess whether the reduction in forecast uncertainty is business cycle dependent. In all final results reported the unemployment rate proved most significant, so that capacity utilisation was subsequently ignored.

From the discussion above it becomes obvious that several influences were potentially acting on price uncertainty at around the same time, introducing possible identification problems as to the exact cause of any regime shift. This includes the implementation of the Reserve Bank Act in early 1990, an election in late 1990 − which brought about a change in government − and the announcement of the inflation target path in early 1991. Furthermore, if one considers the leads in information due to policy announcements, as well as possible lagged policy effects through learning-by-doing, then the list of dummy variables described above may at best only proxy a broad shift in the factors influencing price uncertainty rather than being an exact description. Hence, care was taken to test a composite dummy variable for the combined impact of the Act and PTA,[15] as well as several variations on the election impulse dummy. In all cases, however, the reported results proved the most significant. At present, data limitations hamper the use of more sophisticated methods for identifying possible regime shifts (including recursive regression analysis) remain an area for future research.

B. Hypothesis tests

Several hypotheses regarding the influence of inflation targets are tested on the basis of Equation [7] with a summary of the tests presented in Table 1. First, a null hypothesis that the implementation of the Reserve Bank Act, and subsequent PTA legislation (LEG_t) assist in reducing forecast uncertainty would imply $\beta_3 < 0$. Second, the influence of political business cycles is assessed using the dummy variables POL_t. The acceptance of a null hypothesis that the legislative variables (LEG_t) act to mitigate the influence of political considerations on price uncertainty would imply $\beta_5 = 0$.

Next, as mentioned previously when discussing Equation [6], the significance of lagged price uncertainty ($\beta_1 > 0$) would imply an adaptive mechanism for forecast uncertainty. Although the existence of adaptive behaviour does not rule out the announcement of inflation targets reducing uncertainty, one might expect the size of the coefficients on lagged uncertainty to diminish as a result of the announcement. The same adaptive interpretation can be given to past inflation and its variability, namely that a significant positive coefficient for β_6, β_7, or β_8 also implies some adaptive behaviour in expectation formation. Finally, a negative coefficient is expected for β_9 with uncertainty regarding the direction of inflation declining the larger the output gap.

Examining the behaviour of inflation ($INFL_t$) both with and without the targets variable (TAR_t) in Equation [7] represents another test of the information content of the announced anti-inflation policy. For example, should the targets variable provide more information than past inflation itself, some forward-looking behaviour in expectations formation is implied, adding to the relevance of announcing inflation targets. This hypothesis is assessed by testing for the joint-validity of both $INFL_t$ and TAR_t in the same model.

Finally, Equation [7] assesses the importance of individuals' uncertainty regarding the stance of monetary policy (MON_t) for price uncertainty. It can be claimed that even if the inflation targets help reduce the variance of inflation forecasts, price uncertainty may remain high if monetary policy is perceived to be discretionary or unpredictable. Given that the RBNZ's inflation targeting strategy remains based on a checklist approach and cannot be described by a single

Table 1. **Determinants of inflation uncertainty'**

Adaptive behaviour	$\beta_1 > 0$, $\beta_6 > 0$, $\beta_7 > 0$, or $\beta_8 > 0$
Central Bank independence	$\beta_3 < 0$, $\beta_5 = 0$
Forward looking behaviour	$\beta_2 > 0$
Uncertain monetary policy	$\beta_4 > 0$
Conjunctural climate	$\beta_9 < 0$

1. These coefficients are related to Equation [7].

predictable rule (such as an exchange rate target or a money growth rule), it is of interest to test whether the uncertainty surrounding perceptions of the stance of monetary conditions increases uncertainty. If this were to be the case, one could claim that the provision of more information as to how to interpret the stance of monetary policy would further reduce price-related uncertainty. To accept this hypothesis a significant positive coefficient for β_4 is needed.

V. ESTIMATION RESULTS

The estimation strategy followed four stages. The first was to examine the impact of the legislative variables in cross-section models for the two forecast horizons (current quarter and twelve-month ahead) over the sample period 1987: 3-1992: 3. Attention was then given to the role of past price volatility and the business-cycle influences by adding both (MSD_t) and ($SDRP_t$) and the output gap proxy (GAP_t) to the legislative equations. The third step was to introduce the target variables ($TAR12_t$ and $TAR24_t$) in the specification and assess whether they provide more information than actual inflation ($INFL_t$) in explaining price Uncertainty. Finally, the role of uncertainty relating to the stance of monetary conditions was tested by regressing ESD_{jt} on MON_{t-1}.

At all four stages a "general-to-specific" estimation approach was pursued, commencing with the most general form of the equation and then sequentially removing the least significant variables, taking care at each step to test for any mis-specification. If a variable does not appear in a subsequent table this implies it was statistically insignificant following the introduction of new variables. This approach was favoured as a means of separating the impact on inflation uncertainty of the various types of influences – legislative, political and past time-series behaviour – for discussion purposes. The final equations displayed in Table 4 oriclinate from a general specification which included all variables discussed. The results of the four stages 'are presented in Tables 2 to 4.

A. Legislative influences

Table 2 presents cross-section estimates using various legislative and political dummy variables. Within the current horizon, neither the political-business cycle dummy variables ($PARTY_t$ or $ELECT_t$) nor the legislative variables (PTA_t and $RBACT_t$) were found to significantly influence price-related uncertainty, although the signs were as the earlier described hypotheses suggested. That 'is, the legislative dummies were negatively related to price uncertainty, and the

election dummy positively related. The effect of the political-party dummy was, on the other hand, unstable with the sign changing when entered on their own. The results for the twelve-month horizon were more promising. Again, each of the dummy variables were signed **as** suggested, while in a more restricted regression the $RBACT_t$ variable was statistically significant at the **5** per cent level. As seen in Tables 3 and **4,** the significance of the $RBACT_t$ variable remains robust to various specifications (with a long-run coefficient ranging between –0.26 and –0.39), and appears consistent with the view that the central bank mandate has acted to reduce forecast price uncertainty. However, in the latter regressions, the election dummy is also significant, suggesting that the Act was not sufficient to mitigate all political considerations when forming price expectations.

Table 2. Cross section estimates: impact of legislative and political variables

Dependent variable (ESD_{it})

	End of quarter	End of quarter	12 month	12 month
ESD_{it-1}	0.7541'	0.7445'	0.6041'	0.6105'
	(0.0883)	(0.0782)	(0.0976)	(0.0940)
$RBACT_t$	–0.0043		–0.1193	–0.1301'
	(0.0803)		(0.0865)	(0.0625)
PTA_t	–0.0559		–0.0453	
	(0.0994)		(0.1577)	
$ELECT_t$	0.0509		0.0807	0.1036
	(0.0548)		(0.1040)	(0.0659)
$PARTY_t$	–0.0617	0.0113	0.0223	
	(0.0803)	(0.0323)	(0.1565)	
$adjR^2$	0.72	0.72	0.76	0.76
s.e.	0.1134	0.1112	0.1641	0.1612

Notes: Variables are defined in Section IV. * denotes significance at the 5 per cent level. Standard errors of the coefficients are in parentheses.

B. Price volatility and business-cycle influences

Table 3 summarises the role of business cycle influences *(GAP,)* and price volatility (MSD_t and $SDRP_t$) on price uncertainty. The first notable feature is that the inclusion of the *GAP,* and SDP_t variables markedly reduces the coefficient on the lagged dependent variable, suggesting they have some predictive use in explaining price uncertainty. The positive coefficient on relative price variability is consistent with the theoretical considerations stylised in Equation [6], while the negative coefficient on the unemployment rate – as an output gap proxy – suggests that conjunctural factors also remain important. However, their relative significance is dependent on the forecast horizon, with conjunctural factors (GAP_t)

proving statistically more significant with respect to short-term expectations, and price variability *(SDRP,)* more significant with respect to longer-run expectations. In both the current and twelve-month horizon the *GAP* variable proved statistically more important, with beta coefficients[16] of −0.4 and -0.3 respectively, compared to 0.05 and 0.13 for *SDRP*. In neither forecast horizon was MSD_t found to be statistically significant.

Table 3. Cross section estimates: impact of business cycle, price volatility and targets

Dependent variable (ESD_{jl})

	End of quarter	End of quarter	12 months	12 months
ESD_{jl-1}	0.5193'	0.6026'	0.3388'	0.4008'
	(0.0918)	(0.0874)	(0.1273)	(0.1159)
$RBACT_t$			-0.1381'	-0.2313'
			(0.0579)	(0.0712)
$ELECT_,$			0.0780	0.0802
			(0.0607)	(0.0592)
GAP_t	−0.0536'	-0.0409'	-0.0446'	
	(0.0173)	(0.0182)	(0.0212)	
$SDRP_t$	0.0141		0.0353'	0.0349'
	(0.0093)		(0.0138)	(0.0135)
$TAR\,12/24_{t-1}$		0.0185'		0.0276'
		(0.0061)		(0.0106)
Ommitted variable test (chi-square)				
$INFL_{t-1}$		0.00		0.32
		(0.97)		(0.57)
$adjR^2$	0.78	0.80	0.81	0.82
s.e.	0.1000	0.0972	0.1470	0.1440

Notes:Variables are defined in Section IV. * denotes significance at the 5 per cent level. Standard errors of the coefficiencesare in parentheses.

C.   Target variables and past inflation

To determine whether the gap between actual inflation and the RBNZ inflation target provides additional information on the movements in ESD_{jt}, the $TAR12_t$ and $TAR24_t$ variables were added to the cross-section estimates provided in Table 3. The target variables were found to be significant in both the current and the twelve-month forecast horizon (with beta coefficients of 0.13 and 0.2 respectively), with this result also holding in a more general specification detailed later in Table **4.** However, the output gap variable became insignificant following the inclusion of the target variable and is thus ommitted from the final equation in Table 3. This was also the case when actual inflation was entered, rather than the

target variable, with the output gap proxy (the unemployment rate) becoming insignificant. In order to assess whether past actual inflation has greater power in explaining price uncertainty than the target variables, an omitted-variables test was conducted. Results in Table 3 accept the null hypothesis that past inflation is redundant in the cross-section equations when the target variables are included. This result is consistent with price uncertainty being partially forward-looking and provides some justification for the implementation of inflation targets. That is, the gap between actual and targeted inflation acts as a credibility index of the central bank's performance.

D. Price uncertainty and monetary conditions

In addition to the influences considered above, price uncertainty may also arise if current and future monetary policy actions are perceived to be unpredictable and/or non-transparent. Table **4** presents regressions which examine the influence of individuals' uncertainty regarding the stance of monetary policy on price uncertainty. The uncertainty measures of monetary policy are current mone-

Table 4. Cross section estimates: impact of monetary conditions

Dependent variable (ESD_{jt})

	End of auarter	End of auarter	12 months	12 months	12 months	12 months
ESD_{ij-1}	0.7052'	0.7022'	0.7195'	0.7280'	0.4332'	0.4597'
	(0.0875)	(0.0843)	(0.0607)	(0.0588)	(0.0923)	(0.0777)
MCP_{t-1}	−0.0181		0.0892			
	(0.1232)		(0.1442)			
$MC12_{t-1}$	0.1633	0.1602	0.8367'	0.8549*	1.0983'	1.1447'
	(0.1947)	(0.1919)	(0.2258)	(0.1588)	(0.1979)	(0.1777)
$TAR24_{t-i}$					0.0445*	0.0458'
					(0.0089)	(0.0085)
$SDRP_{t-1}$					0.0064	
					(0.0119)	
$RBACT_t$					−0.1606'	−0.1414'
					(0.0581)	(0.0455)
$ELECT_t$					0.1087'	0.1 109'
					(0.0473)	(0.0468)
Ommitted variable test (chi-square)						
$INFL_{t-1}$						0.19
						(0.97)
$adjR^2$	0.62	0.62	0.71	0.71	0.88	0.88
s.e.	0.1293	0.1282	0.1517	0.1508	0.1144	0.1136

Notes : Variables are defined in Section IV. * denotes significance at the 5 per cent level. Standard errors of the coefficients are in parentheses.

tary perceptions (MCP_t) and monetary expectations twelve months ahead $(MC12_t)$, from the RBNZ Survey of Expectations. Although they are found to be insignificant for the current forecast horizon, monetary policy uncertainty $(MC12_t)$ is found to be significant for the twelve-month ahead forecasts (with a beta coefficient of 0.29). The latter result is robust for a more general specification of the twelve-month forecast, which includes the target, the Reserve Bank Act, and the election dummy, but rejects relative price volatility. The significance of the uncertainty surrounding the stance of monetary conditions suggests that a more transparent operating procedure may prove beneficial to lowering price uncertainty.

VI.   CONCLUSIONS

Several possible determinants of price uncertainty have been examined using a cross-section framework with RBNZ survey data. Although the uncertainty variables proxying the predictability of monetary policy suggest that the RBNZ may benefit from a more transparent operating policy rule, the Reserve Bank Act has significantly lowered price uncertainty and mitigated some of the influences of the political business cycle. Furthermore, the implementation of inflation targets provides a credibility index, with the gap between RBNZ inflation forecasts and actual inflation not only proving significant in explaining price uncertainty, but indeed, more so than past actual inflation. The results suggest that inflation uncertainty in New Zealand has been more strongly influenced by changes in the policy environment than by the time-series properties of past relative and general prices. Although a significant correlation between the dispersion of relative prices and aggregate price uncertainty exists, this proves to be insignificant in the presence of policy-related determinants of price uncertainty.

Although the empirical analysis has relied on survey data from a single country to obtain a proxy for price-related uncertainty, it appears potentially useful to countries either using, or considering implementing, inflation targets as a means of achieving price stability. First, the results suggest that it is the difference between actual and target inflation which appears important to lowering the uncertainty surrounding price expectations, not simply the announcement of infla-tion targets. That is, actually achieving the stated inflation goals is central to establishing credibility, with inflation targets proving most useful as a benchmark against which the public can assess the authorities performance. Second, the results suggest that the legislation underpinning the targets − the Reserve Bank Act − is also important, with the increased central bank independence inherent in the Act somewhat mitigating political and business cycle influences on inflation

over time. Finally, although the targets and supporting legislation have assisted in lowering price uncertainty, there remains some concern related to the actual and future stance of monetary policy at any point in time. This could arise from the fact that inflation targets are not in themselves a policy rule, but only a stated objective. How this objective is then achieved remains to the discretion of the monetary authorities. **A** more transparent operation of policy could therefore help to reduce price uncertainty.

NOTES

1. The current inflation targets are 0 to 2 per cent annual consumer price inflation in New Zealand and Finland (in the latter case to be achieved by 1995), between 1 to 3 per cent in Sweden and Canada, and between 1 to **4** per cent in the United Kingdom (until at least 1997).

2. These include, for example: housing capital costs in the United Kingdom, New Zealand and Finland: indirect taxes in Sweden, New Zealand, Finland and Canada; direct exchange rate depreciations in Sweden; and terms-of-trade shocks and natural disasters in New Zealand.

3. Roughly speaking, a policy is said to be time-inconsistent if there exists an incentive for the policy-maker to renege on an initial policy statement. However, if expectations are formed rationally, policy-makers have nothing to gain as economic agents fully anticipate their intentions to renege, thereby reducing policy credibility in this case. Regarding monetary policy, this can imply the superiority of some fixed rule for money growth as a means of achieving price stability, as opposed to a discretionary policy.

4. The Reserve Bank strategy has been to target a modified CPI which excludes mortgage costs. Since the Gulf War oil prices have also been excluded from the targeted index.

5. Lachler (1988) notes that the dynamics of the disinflationary process can have important consequences for credibility.

6. New Zealand is often cited as a prime example of political business cycle behaviour, see Alesina, Cohen and Roubini (1992, 1993).

7. The checklist variables include: interest rates, the output gap, yield gap, exchange rate, wages and money aggregates. See *OECD Economic Survey, New Zealand* 1993.

8. The framework incorporates the feature of a limited information multi-market rational expectations model as in Lucas (1972) and Barro (1976).

9. The inflation target can be defined in terms of a point estimate or a range. In the empirical section it will be defined as a point estimate.

10. In the following empirical section the systematic component of general inflation (Φ_t) is proxied by actual inflation.

11. The expectations variables include CPI inflation, short and long-term interest rates, trade balance current account, exchange rate, wage growth, and monetary perceptions.

12. The trade-weighted exchange rate index was also included in ESD_{jt} for the above tests, but subsequently dropped because non-normality in the residuals arose from most specifications. Indeed, the trade weighted index of exchange rates is as much a

policy instrument as a target in the latter period, making interpretation difficult (see Grimes and Wong, 1992).

13. In the empirical estimation, described later, variable specific constants were allowed for (see Equation [7]). However, these remained largely insignificant and are not reported.

14. Although the RBNZ bases its policy on CPI excluding mortgage costs and oil prices, the RBNZ forecasts and the survey for inflation do not make these adjustments.

15. This was achieved using a dummy variable which took the value +1 during the period the Act was in place alone, +2 upon the announcement of the inflation targets under the PTA, and zero otherwise.

16. A 0.1 beta coefficient can be interpreted to mean that a 1 standard deviation change in the independent variable will lead to a 0.1 standard deviation change in the dependent variable.

BIBLIOGRAPHY

Alesina, A.G., Cohen, D. and Roubini, N., "Electoral business cycles in industrial democracies," *European Journal of Political Economy* 9, p. 1-23, 1993.

Alesina, A.G., Cohen, D. and Roubini, N., "Macroeconomic policy and elections in OECD democracies," *Economics and Politics* 4, p. 1-31, 1992.

Barro, **R.J.,** "Rational expectations and the role of monetary policy" *Journal of Monetary Economics* 2, p. 1-32, 1976.

Barro, **R.J.** and Gordon, D., "Rules, discretion and reputation in a model of monetary policy," *Journal of Monetary Economics* 12, p. 101-121, 1983.

Batchelor, R. and Orr, A., "Inflation uncertainty, inflation shocks and the credibility of counterinflation policy," *European Economic Review* 35, p. 1385-1397, 1991.

Cukierman, A. and Wachtel, P., "Relative price variability and non-uniform inflationary expectations," *Journal of Political Economy* 90, p. 146-157, 1982*a*.

Cukierman, A. and Wachtel, P., "Inflationary expectations and further thoughts on inflationary uncertainty", *American Economic Review* 72, p. 508-512, 1982*b*.

Cukierman, A. and Wachtel, P., "Differential inflationary expectations and the variability of the rate of inflation: theory and evidence," *American Economic Review* 69, p. 595-609, 1979.

Fischer, A.M., "Inflation targeting: the New Zealand and Canadian cases," *Cato Journal,* Summer 1993.

Grimes, A. and Wong, **J.,** "The role of the exchange rate in New Zealand monetary policy," Pacific Basin Working Paper Series No. PB93-03, 1992.

Lachler, U., "Credibility and the dynamics of disinflation in open economics: a note on the Southern Cone experiment," *Journal of Development Economics* 28, p. 285-307, 1988.

Lucas, R.E., "Expectations and the neutrality of money" *Journal of Economic Theory* 4, p. 103-12, 1972.

Perrson, T and Tabellini, G., "Designing institutions for monetary stability", paper prepared for the Carnegie-Rochester Conference, 20-21 November 1992.

OECD, *Economic Surveys, New Zealand* 1993.

Reserve Bank of New Zealand, *Reserve Bank Bulletin,* various issues.

Walsh, C., "Optimal contracts for central bankers", mimeo, UC Santa Cruz, 1992

RESERVE BANK OF NEW ZEALAND SURVEY OF EXPECTATIONS

The Reserve Bank of New Zealand Survey of Expectations (RBNZ survey) is unique in New Zealand in the sense that it focuses on quantitative estimates of economy-wide variables, as opposed to qualitative answers concerning the respondents' own activities. Although the survey is oriented towards expectations of financial and monetary variables (*e.g.* monetary conditions, prices, interest rates, and exchanges rates), a further section includes questions relating to trends in real activity, the balance of payments, fiscal deficit, and wages and unemployment.

The survey is conducted by the MRL Research Group generally on the second Wednesday of the months of February, May, August, and November, with the results published one month later in the Reserve *Bank Bulletin.* Respondents are grouped into four main activity categories: financial, manufacturing, agricultural, and labour. However, an "other" category is included to cover respondents who do not directly affect actual economic outcomes, but could still influence the formation of expectations — such as economic advisers and commentators. All respondents receive the same set of questions, with no information provided related to past trends of the surveyed variables. Respondents are asked to provide a quantitative answer, or else they are encouraged to respond in the "cannot answer" box if no firm expectation is held. As can be seen from Table AI, the financial and manufacturing sectors comprise the largest groups of respondents, with this having remained broadly stable over the sample period.

Table A.I.   Number of respondents to the RBNZ survey by group
by the 1987-92 period

	LOW	High	Average
Financial	56	89	68.5
Manufacturing	51	80	61.6
Agriculture	17	26	19.7
Labour	4	22	17.6
Other	14	22	17.6
Total number of answers	159	207	178.3
Response rate (per cent)	62	80	67.7

Source: Reserve Bank of New Zealand.