
Assessing alternative inflation targets: growth effects and other costs and benefits

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1 Introduction

The economic environment has changed considerably since New Zealand became the first country to publicly announce an inflation target. Most importantly, disinflation is no longer a problem. Given the current opportunity for reviewing the inflation target, this paper reviews the question of what average inflation outcome might be most conducive to maximum economic growth in the medium term. In doing so, we set aside related questions of whether the inflation target should be a point or a band, and how quickly inflation should be returned to target.

Although we recognise its limitations, in this paper we focus exclusively on the Consumers Price Index (CPI) as the primary measure of inflation in New Zealand. We also restrict our discussion to optimal inflation outcomes, without reference to the role of the caveats in the Policy Targets Agreement (PTA). Finally, we ignore evidence on the costs of disinflation, as New Zealand has already achieved price stability and inflation expectations have been relatively well anchored for a number of years.

By way of historical background, section 2 begins with a brief history of the PTA. We review the choice of 0 to 2 per cent as the original inflation target and briefly discuss the increase of the top of the band to 3 per cent in 1996. One of the key conclusions to draw from this review is that the original target was designed primarily to reduce inflation, rather than derived from a careful evaluation of what might be the optimal average inflation outcome. Much of the literature pertinent to the topic of an optimal inflation target² has been published during and since the growing popularity of inflation targeting over the 1990s. The primary motivation of this paper is to summarise this more recent literature, to

assess what inflation target would be most consistent with the objective of sustainable economic growth.

Broadly speaking, there are two main strands of literature that address the question of what is an appropriate inflation target: the panel data macroeconomic approach, and the partial-equilibrium microeconomic approach. Section 3 summarises the macroeconomic literature, which typically uses cross-country growth studies to investigate the relationship between inflation and growth at alternative rates of inflation. The more recent macroeconomic approaches use non-linear estimation methods to allow for the possibility of a 'threshold', above which there is a significant negative relationship between inflation and growth, but below which there may be no significant relationship between inflation and growth (either positive or negative).

Sections 4 and 5 provide more insight into some of the reasons why there is no clear and robust relationship between inflation and growth at very low rates of inflation. Essentially, these sections assess the specific microeconomic 'sand' and 'grease' effects of low rates of inflation. The sand effects refer to the disruptive nature of inflation, which gets in the way of the smooth turning of the wheels of the economy. Counter-balancing that to some extent, inflation may sometimes serve not as sand, but rather as grease in the wheels, allowing more efficient allocation of resources in the economy. To determine the optimal rate of inflation, these factors need to be balanced against one another. In terms of the costs of inflation (section 4) we discuss: the interaction between inflation and the tax system; liquidity constraints; menu costs; and the costs of unexpected inflation. However, no inflation targeting country has chosen an inflation target of zero, and section 5 reviews the reasons why a very low inflation target may not be desirable. These reasons include: measurement bias in the Consumers Price Index; the role of inflation in facilitating downward adjustments in real wages; and concerns about a zero bound on nominal interest rates.

Section 6 provides concluding comments. The strongest conclusion is that inflation is harmful to growth if inflation is

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² The use of the term *optimal inflation target* by no means implies that there exists a unique optimum. It may be that there are a number of equally valid alternatives.

relatively high (eg exceeding about 10 per cent per annum). But there are much greater uncertainties about the relationship between inflation and growth at very low rates of inflation. As a result, we conclude that the economic literature is unable to tell us whether there would be different growth implications of average inflation outcomes at different points within the 1 to 3 per cent range. We use 1 per cent as the lower bound for this range to reflect the lack of consensus in the literature about the whether zero should be included in an inflation target. Although there is little *economic* evidence to suggest that including zero would be a problem for New Zealand, there are some political economy arguments against zero that should be taken into account.

2 History: How did we get to where we are?

The Reserve Bank of New Zealand Act 1989 requires that monetary policy be directed towards the objective of price stability. Policy targets for monetary policy must be fixed in a public contract negotiated between the Minister of Finance and the Governor of the Reserve Bank. This contract is called the Policy Targets Agreement (PTA).

The PTA prevailing at the time this paper was prepared was signed in December 1999. As an operational target for monetary policy, the then current PTA established an inflation target of annual increases in the CPI between 0 and 3 per cent. Previously, between 1990 and the end of 1996, the inflation target was 0 to 2 per cent. This section provides a brief overview of some of the rationale behind these particular definitions of price stability.

The original target: 0 to 2 per cent

The development of the original inflation target was shaped by New Zealand's history of high and variable inflation. Fifteen years ago — around the time that the objectives of monetary policy were being discussed — the emphasis of policy-makers was overwhelmingly directed towards getting inflation down, rather than towards the question of precisely where the inflation rate should settle in the longer term.

Interestingly, the specification of price stability as 0 to 2 per cent began primarily as a device designed to influence public expectations. As discussed in more detail in Reddell (1999), the first mention of a specific target came not from the Reserve Bank but from the then Minister of Finance, Hon Roger Douglas, in a television news interview on 1 April 1988. In that interview, Mr Douglas stated that inflation would be reduced to “around 0 or 0 to 1 per cent” over the following couple of years. The motivation for this comment, and subsequent supporting statements, was to focus inflation expectations and to convince people that the anti-inflation drive would not stop once 5 or 6 per cent inflation was reached.

At the time, the Minister's commitment to very low inflation was seen as helpful in reducing expected inflation. Reflecting that, the Bank argued that targeting a different range would “jeopardise the credibility achieved” (RBNZ, (1988c)). However, while the Reserve Bank endorsed the general notion of price stability, there was some concern about how large the costs might be to the real economy from rapid disinflation. This led to some initial reluctance to specify specific targets. There were also differing views within the Bank as to the optimal target, with the range of views stemming both from uncertainty about the benefits of absolute price stability and concern about the costs of getting there.

Although the early indication of an inflation target occurred before international academic papers appeared in the 1990s, there was a body of academic literature which argued in favour of a very low inflation rate (eg Brunner and Meltzer (1981)). This literature was reviewed in Reserve Bank publications (eg Greville and Reddell (1990)). While Reserve Bank papers of the late 1980s make little, if any, mention of the advantages of low positive rates of inflation³, the Bank was aware of the earlier literature on nominal wage rigidities (e.g. Tobin (1972)).⁴ But these issues were seen as second-

3 From 1987 onwards, the Reserve Bank's first mention of the potential benefits of targeting a low positive rate of inflation came in Johnson (1993).

4 There was also some attention paid to the demand shift inflation theory of Schultz (1959). In applying this theory to New Zealand, Grimes (1979) noted that “... policies predicated on the belief that restrictive monetary and fiscal policies will be effective in restraining inflation could be doomed to failure while at the same time contributing to increased unemployment” (p. 73).

order problems given the main focus of eliminating persistently double digit inflation. In addition, there was a general sense that nominal rigidities would dissipate in an environment of price stability and liberalised labour markets. Another important influence on the emergence of the 0 to 2 per cent target was a sense of the growth advantages that low inflation seemed to have brought to Germany, Japan and Switzerland at that time.

Over time then, there gradually emerged a view that to eliminate inflation-related distortions completely, absolute price stability was desirable. Because of CPI measurement bias, however, it was appreciated that zero true inflation is achieved when the CPI is increasing by about 1 per cent per annum, as illustrated by the following quotation.

"...price stability is the legislated goal for monetary policy but there is nothing sacrosanct about the current definition of price stability as 0-2 per cent annual CPI increases. The rationale for the adoption of this specific definition was that measurement difficulties implied that the annual CPI inflation rate may overstate actual inflation by approximately 1 per cent. Hence a measured CPI inflation rate of 1 per cent was taken to correspond approximately to price stability; and a band of 1 per cent either side of this rate then formed the policy target" (RBNZ, 1990, p.29).

The current target: 0 to 3 per cent

The inflation target was changed to a 0 to 3 per cent range following the 1996 general election. This change was initiated by the new Treasurer, Hon Winston Peters.

The Reserve Bank's 1996 briefing paper discussed alternative inflation targets, but only in the context of a wider or narrower inflation target (RBNZ (1996) pp. 21-23). The Bank argued that the target should be tight enough to constrain the Bank's behaviour in formulating policy, but not so tight that it would undermine public confidence in the Bank's ability to deliver inflation outcomes within the range most of the time. In particular, the Bank stated that *"a target range much narrower than the current range would probably lack much credibility as an indicator of the likely range of most inflation outcomes"* (p.22). But because of *"the normal pressures on policy"* a wider target range was regarded as

likely to result in *"inflation outcomes more commonly near the top of the range than near the bottom of the range and average inflation correspondingly higher"* (p.23).

The 1996 briefing paper did not explicitly discuss the costs and benefits of targeting alternative low positive rates of inflation. Rather, comments (on p. 21) suggest that the Bank continued to advocate a non-zero target only to account for measurement bias.

3 Inflation and growth: A macroeconomic approach

As the 1999 PTA puts it, the Reserve Bank aims for price stability "so that monetary policy can make its maximum contribution to sustainable economic growth". The objective of this paper is to assess whether the current operational target is consistent with this goal.

This section summarises the empirical literature on the relationship between inflation and economic growth. We are particularly interested in the relationship between inflation and growth at low rates of inflation.

3.1 The early growth-inflation literature

Before focusing on the more recent inflation threshold studies (ie those studies that evaluate whether there is an inflation threshold above which higher inflation is harmful to growth), this section provides a brief overview of the key results from the literature that uses linear estimation methodologies to assess the relationship between inflation and growth. For a more comprehensive review of the inflation and growth literature see Temple (2000).

To some extent, the relationship between inflation and growth varies according to the sample period. Bruno and Easterly (1995) review the nature of the relationship between inflation and growth in the 1950s, 1960s and 1970s. During the 1950s and 1960s, many studies found that there was either no relationship, or a positive relationship, between inflation and employment. However, once the high inflation

and low growth years of the 1970s and early 1980s were included, the relationship became strongly negative.

The Reserve Bank's interpretation of this literature was probably influenced to some extent by the results of Grimes (1991). Grimes used panel estimation over 21 industrial countries and a 27 year time span, and found that a sustained 1 per cent annual inflation rate is estimated, on average, to lead to a growth rate that is 0.1 percentage points lower than would have otherwise occurred. He concluded that this relationship was not sensitive to the inclusion of high inflation rates. In other words, this relationship was interpreted as holding at low, as well as at high, rates of inflation.

Compared to the results from other studies, Grimes' work suggests an unusually large negative coefficient on inflation compared with other research. A more representative study would be Barro (1995), who used data from about 100 countries from 1960 to 1990 to estimate the relationship between inflation and growth. After controlling for other determinants of growth that vary across countries, he found that 1 per cent higher inflation causes a fall in real per capita GDP growth of 0.02-0.03 per cent per year. Although Barro's coefficient estimates are only $\frac{1}{5}$ to $\frac{1}{3}$ the size of those in Grimes, Barro's results still imply a relatively substantial impact of inflation on living standards. Over a 30 year period, Barro's results suggest that an inflation rate that was 1 per cent higher on average would lower the level of real GDP by 0.6 to 0.9 per cent.

One drawback of Barro's study is that it includes developing countries, which may be systematically different from developed countries in some way not captured by Barro's other variables. When the high inflation observations are excluded from Barro's sample, he finds that there is no longer a statistically significant relationship between inflation and growth. This highlights the very significant difference between the results of Barro and Grimes, who used only industrial countries.

Other studies, such as Andres and Hernando (1997), conclude that the negative relationship between inflation and growth is robust even when the high inflation economies are excluded.⁵ Still other studies find it difficult to establish a robust relationship between inflation and growth at all (eg Levine and Zervos, 1993).

In summary then, a large number of cross-country studies have found a negative relationship between inflation and growth. However, there is little consensus as to the extent to which the results depend on the inclusion of high inflation countries and samples. This makes it difficult to assess whether or not the relationship between inflation and growth varies at alternative low positive rates of inflation. A more general problem with such cross-country regression analyses is that the long-run (potential) growth rate is not observable at any given point in time, which makes inferences about the effects of inflation on growth from time series data extremely fragile (Temple 2000). Nevertheless, it is fair to say that many studies conclude that high inflation is harmful to growth.

3.2 Recent threshold studies: is the relationship non-linear?

Given the different results from cross-country growth studies based on the 1970s and 1980s versus the 1950s and 1960s, together with uncertainty about how sensitive the results are to the inclusion of high inflation countries, some economists have proposed that the relationship between inflation and growth may be non-linear. That is, they propose that the marginal growth effect of changes in inflation depends on the rate of inflation. If true, then by imposing a linear relationship it would not be surprising that many studies have struggled to identify a relationship between inflation and growth that is robust across countries and inflation rates.

This section discusses the results of the "threshold studies" that allow for non-linearities (see table 1 for key results). Consistent with the linear estimation results discussed above, all the studies referred to below find a negative effect of inflation on growth above some threshold level. Although these studies disagree as to exactly where the threshold is, they generally indicate that the negative effect of inflation may apply at much lower rates of inflation, than indicated by the linear literature discussed in section 3.1. Indeed,

5 Andres and Hernando's results were found in the context of "convergence" theories. Convergence theories postulate that countries with lower initial income levels grow faster, allowing the income levels to converge. See Barro and Sala-i-Martin (1991, 1999), and Sala-i-Martin (1996) for a detailed analysis of convergence.

Table 1
Threshold studies on the relationship between inflation and growth

Authors	No. of countries	Sample Period	Estimated Threshold	Relationship between inflation and growth	
				<i>Above threshold</i>	<i>Below threshold⁷</i>
Sarel (1995)	87	1970-1990	8 %	Negative	Zero or negative
Ghosh and Phillips (1998)	100 full-sample 26 upper & upper-middle income countries	1960-1996	2-3 % ⁸	Negative	Zero or negative
Burdekin, Denzau Keil, Sitthiyot and Willett (2000)	27 industrial 51 developing	1967-1992	8 % (industrial countries)	Negative	Zero or negative
Khan and Senhadji (2001)	140	1960-1998	1% (5 yearly data industrial countries) 3 % (annual data industrial countries)	Negative	Positive
				Negative	Positive

whereas previous papers indicated that only inflation above 10, 20, or even 40 per cent had negative effects on growth, the non-linear papers suggest that the negative effect may apply at 8, 3, or even 1 per cent inflation.

In addition to the above conclusion, one of the studies that uses non-linear estimation also finds that, below some threshold level of inflation, higher inflation may be beneficial to growth. However, the other studies find that the relationship between inflation and growth below the threshold is insignificant.

Table 1 summarises the key results of the papers that use non-linear panel estimation across a number of countries to estimate the threshold.

The first of the empirical papers to use this methodology was Sarel (1995). His research identified a structural break in the relationship between inflation and growth. When inflation is above the threshold, a rise in inflation has a negative and statistically significant effect on growth. When inflation is below the threshold, an increase in the inflation rate has a small positive (but not statistically significant) effect on the growth rate. Sarel estimated the structural break to occur at an average inflation rate of 8 per cent. Thus, Sarel's paper implies two things. First, additional inflation above 8 per cent has significant detrimental effects on growth.

⁶ When inflation is less than 8 per cent, Sarel finds its effect on growth to be positive but very weak and statistically insignificant. On the other hand, the negative growth effect of inflation greater than 8 per cent is not only significant at the 1 per cent confidence level but also extremely powerful.

Second, additional inflation below 8 per cent is not harmful for growth, even if not beneficial.⁶

As mentioned in section 3.1, one of the main difficulties with cross-country growth studies is the pooling of both developing and industrial countries in the growth analysis (eg as in Sarel (1995)). As a result, the more recent threshold studies have distinguished the industrial countries from the developing countries. Using industrial country samples only, and a similar methodology to Sarel, both Ghosh and Phillips (1998) and Khan and Senhadji (2001) estimate the threshold to be in the range of 1 to 3 per cent inflation. They find significantly higher thresholds for developing countries. More surprisingly, Burkedin, Denzau, Keil, Denzau and Klein (2000) estimate the threshold for developing countries to be lower (3 per cent) than the threshold for industrial countries (8 per cent).

Taking a closer look at the significance of the relationship between inflation and growth, we can make the following observations.

First, all of the studies find that, above the threshold, there is a clear and robust negative relationship between inflation and growth. In most cases this relationship is convex, so

⁷ Zero means that the coefficient is statistically insignificant while positive or negative indicates the sign of the coefficient.

⁸ Although the paper finds the threshold to be between 2 and 3 per cent, the estimated model reports the threshold as 2.5 per cent. This is probably due to averaging.

that the decline in growth associated with an increase from 10 per cent to 20 per cent inflation is much larger than that associated with moving from 40 per cent to 50 per cent. Importantly, whereas previous papers indicated that only inflation above 10, 15 or 20 per cent had negative effects on growth, these non-linear papers suggest that the negative effect may apply at 8, 3, or even 1 per cent inflation.

Second, even though the non-linear studies suggest that the inflation threshold (above which inflation imposes costs on the real economy) is lower than in the earlier linear studies, there is no consensus as yet on the level of this threshold, other than that it is likely to be in the range of inflation of 1 to 8 per cent.

Third, below the threshold, we find that the results vary between studies. Most studies find that, below the threshold, the authors cannot reject the null hypothesis that the relationship between inflation and growth is zero.

To expand on these results a little more, we note that Ghosh and Phillips find that the sign on the relationship between inflation and growth depends on the specification of the equation that they use. For their full sample of IMF member countries (not reported in table 1) they find that the coefficient on the dummy variable for the threshold of 2.5 per cent is positive and statistically significant at the 95 per cent level. Unfortunately, however, the authors do not report the "joint-significance" of the dummy and inflation variable in the model. Therefore we cannot be sure whether the "net effect" of the positive dummy variable combined with the normal negative effect of inflation would be significant or not.

For the smaller sample of upper and upper-middle income countries (the sample more relevant for New Zealand), Ghosh and Phillips find that the dummy variable for the threshold of 2.5 per cent is still positive, but statistically insignificant. However, the combined effect of the dummy variable and the inflation variable suggests that the relationship between inflation and growth is negative below the threshold, as well as above the threshold. As a result, Ghosh and Phillips' results suggest that, for industrial countries at least, the correlation between inflation and growth below the threshold is close to zero.

The Reserve Bank's Briefing to the Incoming Government in

1999 discussed the findings of Ghosh and Phillips' (1998) paper in the context of specification of the inflation target, but argued that the issue was still unsettled (Reserve Bank, 1999).

Similarly, Burdekin et al (2000) also find that the relationship between inflation and growth below the threshold is statistically insignificant. However, an additional conclusion from Burdekin et al is that deflation is harmful for growth, whereas most of the other threshold studies do not consider deflation at all.

Unlike the other threshold studies, Khan and Senhadji (2001) find a statistically significant *positive* relationship between inflation and growth below the threshold.⁹ However, they also find that the relationship varies not only between developed and developing countries, but also depending on whether they use annual or five yearly average data. For developed countries with annual data, they find the threshold to be at 3 per cent. With five yearly average data, the threshold is at 1 per cent.¹⁰ They find these results to be robust to a range of specifications.¹¹ However, there are reasons to be very careful in our interpretation of these results. Importantly, in the data sample using 5-yearly data, there are only 12 observations with an inflation rate of below 1 per cent. These are too few observations from which to draw conclusions about the correlations below the threshold.

There are other non-linear studies that also estimate the threshold for transition economies only (eg Christoffersen and Doyle, 1998). We do not report the results of these studies here.

⁹ The positive relationship below the threshold is only statistically significant for the sample of industrial countries.

¹⁰ For developing countries, annual data gave a threshold of 12 per cent and five yearly data gave a threshold of 11 per cent.

¹¹ For example they use a number of different methodologies and robustness tests and test for the sensitivity of results to additional explanatory variables, to see if there was an omitted variable bias in the estimation. Because of the emphasis given to human capital by the endogenous growth theories, they include a human capital variable as well as financial development and fixed effects for individual countries. The inclusion of these variables does not change the threshold levels, which they estimate to be statistically significant at 1 per cent or less. Furthermore, the confidence intervals for the threshold estimates are very tight implying precise estimates (standard errors are reported in Table 2).

A significant drawback of these studies is the difficulty in making inferences about the effects of trend inflation on trend growth. For example, the higher threshold level that Khan and Senhadji obtain using annual data could be due to the business cycle or “short-run Phillips Curve” effect. Because the dependent variable is actual growth and not trend growth, annual data therefore includes business cycle effects and hence the short-run trade-off between inflation and output. Although Khan and Senhadji state a preference for their estimates using annual data, they also report that the annual data give a reduced fit compared with the five yearly data, although the precision in the estimation of thresholds remains roughly unchanged. We also note that the five yearly average data also have problems. Although averaging may diminish some of the business cycle effects, five yearly intervals are arbitrarily chosen. It is possible that different choices for the beginning or the end of the five yearly intervals may change the results significantly. In addition, as we noted earlier, there are only 12 observations below 1 per cent inflation. Thus it is likely that we will have to wait for more data – particularly more data from low inflation regimes with established monetary policy credibility, rather than isolated observations from temporary low-inflation periods – before we can draw conclusions about the relationship between inflation and growth at very low rates of inflation.

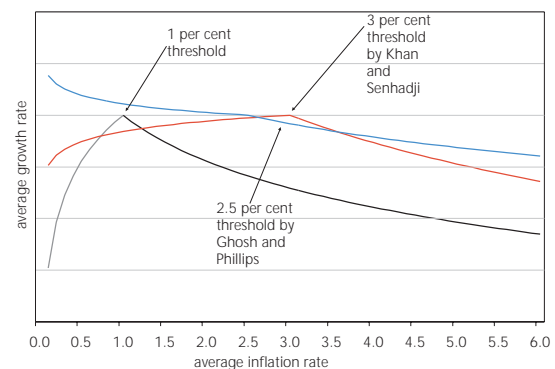
We believe that insufficient observations and the difficulties in identifying the relationship between trend inflation and trend growth are the main shortcomings of these papers. Burdekin *et al* (2000) attempt to overcome the short-run Phillips curve effect by including a first difference term as an explanatory variable. They find strong evidence for this effect. A related danger is the possibility that the positive relationship between inflation and growth at low rates of inflation may just be reflecting the cyclical growth upturns that occurred at the end of the disinflationary periods of the 1980s and the 1990s. This argument has been made by Bruno and Easterly (1996).

Figure 1 shows a graphical representation of the results from Ghosh and Phillips and Khan and Senhadji. Due to the different estimation techniques used in the two papers, it was not possible to depict Khan and Senhadji’s estimated relationship on this chart alongside the results of Ghosh and

Phillips without adding a constant to the former model. Thus, to aid comparison, we have chosen a constant for all three models that equalises the level of the three different thresholds. As a result, the reader should not focus on the level of the lines, but rather on their slope, which depicts the magnitude of the trade-off between inflation and growth, above and below the threshold.

In recognition of the problem of very few low inflation observations, we have depicted the relationship to the left of the thresholds in light colours. This highlights the relatively more certain results that are estimated for rates of inflation above the thresholds.

Figure 1
Graphical representation of threshold relationships estimated by Ghosh & Phillips (1998) and Khan & Senhadji (2001)



This figure serves to highlight the following conclusions from these studies, as discussed above:

- The position of the threshold varies significantly between studies, ranging from 1 per cent at the low end to 8 per cent at the upper end (not shown in figure 1).
- Above some threshold level of inflation, the relationship between inflation and growth is significantly negative.
- Below the threshold level of inflation, there is much greater uncertainty about the relationship between inflation and growth. For example, Ghosh and Phillips find this relationship to be close to zero. On the other hand, Khan and Senhadji find this relationship to be positive, and significantly different from zero. However, in the case of their 3 per cent threshold model, the slope is very gradual and not significant in economic terms.

Also, given the relatively few five yearly data observations below 1 per cent, the positive relationship below the threshold needs to be interpreted with caution.

For completeness, we also note that there are two other papers, not included in table 1, that use similar techniques, but with different objectives and focus. First, Bruno and Easterly (1996) define an inflation crisis as annual inflation greater than 40 per cent for two or more years, and then proceed to estimate the relationship between inflation and growth above and below that threshold. Thus, although they found a “non-linear” relationship between inflation and growth, their threshold is “pre-imposed”, which makes their results quite different from those cited in table 1.¹²

Second, Barnes (2001) uses threshold analysis to estimate the relationship between inflation, financial market development and growth. The data set in this study includes 49 countries with five year intervals, making up a total sample size of 294. She estimates a threshold of roughly 14 per cent. However, the intention of her model is to assess only the effects of financial development across countries. In that sense, her model is less of a complete analysis of the relationship between inflation and growth than the other studies.

Finally, we refer to Judson and Orphanides (1999), who re-examined the relationship between inflation and growth by adding inflation volatility into their model. They found inflation volatility to be negatively and robustly related to income growth for all countries and levels of inflation. They also found the negative relationship between inflation and growth to be very strong for all but low inflation countries. In other words, their conclusions suggest that there is a negative relationship between inflation and growth at high levels of inflation, but that the relationship is much less clear at low rates of inflation.

Overall, the conclusions we draw from the growth-inflation literature are as follows:

- High levels of inflation are detrimental to growth. The literature comes to no firm view as to what level of

inflation qualifies as being “high”. However, for industrial countries, the more recent studies indicate that the threshold at which inflation has negative effects on growth may be lower than previously estimated.

- As yet there are only a handful of studies using non-linear estimation techniques, and for those studies that identify a threshold, the estimates of the threshold vary significantly.
- At low positive rates of inflation (ie below the “threshold”) the sign and the size of the relationship is more ambiguous, with the majority of studies finding a zero correlation between inflation and growth.
- There are a number of significant problems with this type of research. These include the difficulty of separating the short-run Phillips curve effect from the long-run effect, the relative lack of low inflation observations from credible monetary policy regimes, and the applicability of cross-country results to individual countries.

In other words, while there is increasingly significant evidence that inflation rates above some point are detrimental for growth, there still remain significant clouds over the “true” nature of the relationship between inflation and growth at very low rates of inflation. However, on the basis of the literature that we have reviewed, it would be difficult to conclude that average rates of inflation in New Zealand have been sub-optimal.

4 “Sand” effects: the costs of inflation

The previous section concluded that there may be some non-linearities in the relationship between inflation and growth. But that literature did not provide any explanation as to the microeconomic factors that might be driving that relationship. There is, however, an extensive literature that describes, and in many cases quantifies, specific costs and benefits of inflation. An early New Zealand summary is provided in Greville and Reddell (1990), a *Reserve Bank of New Zealand Bulletin* article whose purpose is to explain why the achievement of price stability is important. The emphasis

¹² Dornbusch and Fischer (1993) suggest that inflation becomes very distorting when it reaches 35-40 per cent per annum. Bruno and Easterly used this as a guide to pre-impose their threshold level.

Table 2
Implications of inflation for post-tax real interest rates
(assuming 33% tax rate)

Inflation rate (%)	Nominal interest rate (%)	After-tax real interest rate (%)
1.5	5.5	2.185
2.5	6.5	<u>1.855</u>
		-0.33

on the achievement of price stability suggests that the main goal at that time was to explain the costs of high inflation, rather than to distinguish between the differential costs and benefits of specific low inflation target alternatives.

This section reviews each of the main mechanisms through which inflation can have adverse effects on the economy. Broadly speaking, most of the costs of inflation accrue even when inflation is fully expected, although there are some additional costs that stem from unexpected inflation. Section 5 then follows up with the arguments in favour of targeting small positive rates of inflation (rather than zero inflation).

4.1 Inflation as a tax on money balances

Often referred to as 'shoe leather costs', inflation acts as a 'tax' on money balances by eroding the real purchasing power of such balances, leading people to incur costs as they economise on their use of money. As a result, Milton Friedman suggested that the ideal inflation rate would be equal but opposite in sign to the (neutral) real interest rate (Friedman, 1969). With a negative inflation target, the nominal interest rate would then be zero, making the return to holding money the same as the return to holding other assets. In this way, the costs associated with people economising on their holdings of money would be eliminated.

However, since inflation is a tax, and that many taxes are distortionary, some positive rate of inflation must be appropriate in the context of an optimal tax structure - ie it would not make sense to fully eliminate the tax on money balances if other more costly problems would result. The damage that deflation can engender, also argues against Friedman's rather extreme position.

A number of papers have calculated partial equilibrium estimates of how much the demand for money varies with

the nominal interest rate, thus producing a range of estimates of the cost of the inflation tax.¹³ However, it is also worth noting that the magnitude of this distortion has probably fallen over time as interest-bearing cheque and debit accounts have become more common. The following section discusses a number of studies that quantify the net welfare impact of small changes in the inflation rate, including the impact of taxing money balances.

4.2 Interaction of inflation with the tax system

Because the tax system is not fully indexed, inflation exacerbates the inefficiencies already created by taxation and increases the rate of taxation on capital-based income. This is because taxes are paid not only on the real return but also on the component of the return that is required to maintain the real value of the asset. Thus, both business profits and nominal interest payments to savers are over-taxed. Inflation therefore depresses the after-tax real interest rate on financial instruments and distorts price signals within the economy. In turn, this implies a transfer of wealth from financial savers to borrowers.

The table above demonstrates the impact of inflation on after-tax real interest rates. The first row shows what the after tax real interest rate will be if inflation is 1.5 per cent, the real interest rate 4 per cent and taxes 33 per cent. The second row shows what the after-tax real interest rate will be if inflation increases to 2.5 per cent, all else being equal. The difference between the two (a decrease of 0.33 per cent percentage points) is the inflation-induced distortion.

The economic literature discusses the magnitude of four specific types of distortions that arise from this impact of

¹³ For example, Table 4, p 328 of Black, Coletti & Monier (1997) suggests that the welfare cost of a sustained 2 per cent per annum inflation rate (rather than 0 per cent) would be in the range of 0.04 – 0.12 per cent of GDP per annum.

inflation on the after-tax real interest rate: consumption timing, housing demand, money demand and debt servicing. In the remainder of this section we briefly discuss each of these and provide some of the estimates from the literature. In terms of presenting these estimates, we follow the literature by quantifying the annual impact on welfare of reducing the inflation rate. However, if we were to consider raising the average rate of inflation in New Zealand then we would need to reverse these estimates.

The first of the distortions, the impact of inflation on consumption timing, is the most costly distortion. The decline in the economy's overall after-tax real rate of return leads consumers to redistribute their consumption away from the future and towards the present. To analyse the dead-weight loss that results from this distortion, studies usually consider a simple two-period model of individual consumption. As inflation increases, consumers increasingly bring forward their consumption into period one. Standard techniques from welfare economics enable a monetary value to be attached to the amount by which an individual's utility would be enhanced if the timing of their consumption is not distorted. More technically, the welfare costs are obtained by evaluating the appropriate area under the individual's compensated demand curve for consumption in the second period (which can be thought of as the retirement phase of life). This was the methodology used by Feldstein (1996), and applied to New Zealand by Bonato (1998). For New Zealand, Bonato estimates that the annual welfare benefit from reducing true¹⁴ inflation from 2 per cent to zero per cent would be equal to somewhere between -0.06 per cent of GDP (ie a net cost) and +0.56 per cent of GDP (a significant benefit).

The second distortion, that of housing demand, is estimated by Feldstein (1997a,b) to be moderately large for the United States. The distortion stems from the fact that, although local property taxes (and, in the United States, mortgage interest payments) are deducted from taxable income, no tax is imposed on the implicit rental return on the capital invested in the property. This special tax treatment of owner-occupied housing induces "too much" consumption of housing services, even in the absence of inflation. In New

Zealand, however, the fact that mortgage payments are not tax deductible means that the magnitude of the housing demand distortion from inflation is very small.¹⁵ An additional possible source of distortion to housing demand in New Zealand is that which stems from the fact that most capital gains on housing are not taxed, unlike the capital gains from most other forms of income. This potential source of distortion was not considered by Bonato. In terms of international comparisons, however, it is unlikely to distinguish New Zealand, since many other countries also exclude housing from capital gains tax.

The third distortion, money demand, is also small, and comprises a number of offsetting effects. As discussed in section 4.1, inflation has the effect of reducing money balances below their optimal level. A reduction in inflation reduces this distortion. This gain from reducing inflation must, however, be offset against the fact that price stability reduces seigniorage revenues as well as business tax revenues, since the lower opportunity cost from holding money balances results in a transfer of capital out of business assets, and into money. Finally, reduced inflation lowers the cost of servicing government debt. In New Zealand, the negative tax revenue effects from reducing inflation are estimated to dominate the positive welfare effect of no longer penalising cash holdings. Nevertheless, the overall effect is very small.¹⁶

The final distortion is the impact of inflation on the real cost of servicing government debt. A reduction in inflation reduces tax revenue from the inflation premium on government debt payments. This in turn requires a higher level of other distortionary taxes. In terms of welfare this implies a cost of reducing inflation, but one which only partly offsets the benefits of reducing the distortion on the timing of consumption.¹⁷

¹⁴ The term *true* inflation refers to the rate of inflation after correcting for measurement error (see section 5.1 for further discussion of measurement error).

¹⁵ Bonato (1998) estimates a range for this distortion of between 0.04 and 0.06 per cent of GDP for New Zealand. This contrasts with Feldstein's estimate of between 0.22 and 0.55 per cent of GDP for the US.

¹⁶ Bonato (1998) estimates the cost of reducing the money demand distortions as between -0.01 and -0.03 per cent of GDP (ie a net benefit). By way of contrast, Feldstein (1997b) estimates a cost of between -0.03 and -0.17 per cent of GDP for the US.

¹⁷ Bonato (1998) estimates the cost of the government debt servicing as between -0.03 and -0.13 per cent of GDP (ie a net benefit). By way of contrast Feldstein (1997b) estimates a cost of between -0.10 and -0.38 per cent of GDP for the US.

Table 3

Net annual welfare effect of achieving "true" price stability

(measured as a percentage of GDP for an inflation reduction of 2 percentage points)

	Range of estimates		Base case
	Low	High	
New Zealand (Bonato, 1998)	-0.16	+0.57	+0.39
USA (Feldstein, 1997b) ^{19,20}	0.08	+1.77	+0.76
Spain (Dolado <i>et al</i> , 1997)	+1.71	+2.87	+1.71
Germany (Todter & Ziebarth, 1997)	---	---	+1.41
UK (Bakhshi, Haldane & Hatch, 1998)	-0.34	0.37	+0.21

Note: a positive number represents a net welfare *gain* from *reducing* inflation.

By adding up the four distortions discussed above, table 3 presents Bonato's results for New Zealand alongside results for other countries. Since the results are dependent on a number of uncertain parameters, a range of results is presented.¹⁸

As noted above, the numbers reported in table 3 are annual changes in welfare. Following the standard that Feldstein set, the papers then go on to compare the benefits of lower inflation (as cited here) with the costs of disinflating. Since the costs of disinflating are temporary, but the benefits are permanent, the comparison involves offsetting the one-off output costs against the discounted stream of future benefits. However, there is no need for us to consider that step in this paper since we are concerned only with the permanent effects of changing the average inflation rate, rather than with the transitional effects of getting there

The low end New Zealand estimate in table 3 of -0.16 per cent of GDP is based on the following parameter values: a zero elasticity of savings with respect to the interest rate ($h=0.0$); and a relatively high dead-weight loss from the increase in taxation that would be required to make up the loss in seigniorage (and other tax) revenues ($l=0.65$).²¹ With

this selection of parameters, household savings are unaffected by the fall in the interest rate, and significant costs are incurred by raising taxes elsewhere to compensate for the lower inflation tax. In contrast, at the high end of the range, the parameters are $h=1.0$ and $l=0.14$. In this case, reducing inflation has a large adverse impact on savings, but little adverse impact on the dead-weight loss of substitute taxes. Thus, in this high end scenario there is a significant net welfare gain from reducing inflation to price stability.

Even the high-end of the range of plausible estimates in Bonato (1998) is lower than the base case gain of +0.76 per cent of GDP as estimated by Feldstein (1997b). Bonato explains that this is because the New Zealand tax system is less distortionary than the United States tax system in the following ways:

- The full imputation system in New Zealand's tax system eliminates the double taxation of dividends that characterises the United States system.
- Unlike the United States, New Zealand does not generally tax capital gains at the personal level and this lowers the tax wedge on savings.
- Corporate and personal income tax rates are better integrated in New Zealand. Note, however, that since Bonato completed his work, the top marginal tax rate in New Zealand has been raised to 39 per cent despite the corporate tax rate remaining at 33 per cent. This change will have increased the distortions in the New Zealand tax system and, if Bonato's work were updated, would imply slightly larger net gains to reducing inflation in New Zealand than reported in table 3 above.
- The tax advantage of owner-occupied housing in New Zealand is reduced by the fact that mortgage payments

¹⁸ Bonato and White (1997) have pointed out that while the welfare gains are expressed relative to GDP, this does not mean that they can be strictly interpreted as output gains.

¹⁹ Note that Feldstein's (1997b) base-case estimate of 0.76 per cent of GDP corrects downward his previous estimate of 1.01 per cent (Feldstein, 1997a).

²⁰ Akerlof, Dickens & Perry (2000, p. 23) point out that Feldstein's calculations fail to take into consideration the tax sheltering of pension plans, 401k's etc. As a result they argue that Feldstein's estimates overestimates the deadweight losses from the tax distortions of going from zero to two per cent (true) inflation.

²¹ The parameter l corresponds to the dead-weight loss per one dollar of additional taxes.

are not tax deductible. However, it is unclear how distortions that stem from excluding housing from capital gains taxes would compare with similar distortions in other countries.

What do the other international comparisons in table 3 tell us? In Germany and Spain, the net welfare gain from achieving true price stability is estimated to be much larger than in New Zealand. In the case of Spain, Dolado *et al* (1997) attribute this mostly to the fact that the tax privileges given to owner-occupiers are quite generous by international standards, thus leading to larger distortions in the demand for housing in Spain²². In the case of Germany, the higher net gain from reducing inflation is attributed to their high savings rate, and high rates of tax on capital income.

For the United Kingdom, on the other hand, the net welfare gain from reducing inflation was estimated as being only about half the size of that in New Zealand, and a third to a quarter the size of that in the United States. Bakhshi *et al* (1998) attribute this to the nature of the tax system in the United Kingdom.

In summary, this literature has highlighted an important cost of inflation, although the precise estimates of the interaction between inflation and the tax system remain uncertain. To minimise these costs, there are three possible approaches. First, the specific costs of inflation discussed in this section would be fully eliminated if income taxes were fully replaced by consumption taxes. Smaller reductions in cost could be achieved via a more efficient tax system (although we note that New Zealand's tax system is already more efficient than those in the United States and some European countries).

A second fiscal policy response would be to fully index the income tax system to inflation. Attempts were made in the 1980s to inflation-index accounting statements, but it proved very difficult to create something that would be workable. The third possibility would be to reduce the average inflation rate to zero. We judge that none of these policy options is likely to be viewed as feasible, at least in the near term.

²² It is also interesting to note that while Dolado *et al* estimated much larger benefits of achieving price stability in Spain (vs the US), they also estimated much greater costs of achieving price stability, thus leading to a similar net balance as in the US. Note that in this paper we do not discuss this other side of the equation (the costs of disinflation).

However, while these costs are unlikely to be fully eliminated in the near-term, we would emphasise the role that fiscal policy, as well as monetary policy, plays in their existence.

4.3 Inflation and liquidity constraints

Given the institutional structures and conventional limits operating in the market for credit, inflation can have an important adverse impact on the economy by constraining the cashflows of businesses and households. Even if the real interest rate is unchanged, a higher nominal interest rate will impose a much heavier mortgage servicing burden as a proportion of income. As a result, higher nominal interest rates typically increase the real repayments in the early stages of loan repayment, but lower the real repayments required later (given that higher inflation erodes the real value of the debt).

By making it harder for households to maintain the level of borrowing they would choose to undertake if inflation were zero, an increase in anticipated inflation is thus likely to cause a decrease in household consumption and investment. These liquidity constraints are also important for small businesses. When inflation and nominal interest rates rise, firms' cashflow declines. If there is asymmetric information, so that there is a wedge between the cost of internal and external funds, this reduction in cashflow causes the firm to cut back on investment when it has desirable investment opportunities. Since New Zealand has a lot of small firms, this cost of inflation could be quite important.

The liquidity constraints associated with inflation could be completely avoided by issuing inflation-indexed loans. Under indexing, borrowers would essentially service the real interest accruing on their loan, and the nominal value of the loan would increase annually by the rate of inflation. However, the fact that such loans are not common, even in times of quite high inflation, suggests either that there are relatively significant costs associated with them, or that borrowers do not typically find the cashflow distortion to be a major issue.

4.4 Menu costs

Menu costs are the direct costs associated with changing prices (re-labelling products, recalculating wages etc). If inflation is zero, menu costs will only occur with changes in

relative prices. But higher inflation will require more frequent changes in all prices. Most of the literature suggests that these costs are likely to be small when inflation is low (eg Edey, 1994, cited in Black, Coletti & Monier). Also see Cassino (1995) for a detailed review of the menu cost literature.

4.5 Costs of inflation variability

There is some evidence that high inflation rates are associated with more variable inflation (for example, see Davis and Kanago (2000) and their references). Also, when inflation is high it is more difficult to distinguish relative price changes from changes in the aggregate price level, thus reducing the ability of the price system to allocate resources effectively.

The costs of inflation variability primarily relate to the risk that accompanies inflation uncertainty. When inflation is uncertain, the costs of living and of running a business become more variable. If people are risk averse they try to mitigate these risks by hedging cashflows, shortening the duration of contracts, or writing more detailed contracts. This effort reduces the time spent in production. Firms may also switch production to goods with more predictable income streams. If these lower risk activities have lower returns, then production will be lower when inflation is uncertain.

5 “Grease” effects: Can inflation be too low?

In his presidential address to the American Economics Association in 1972, James Tobin argued that the optimal rate of inflation is greater than zero. Essentially, the rationale of his argument was that some positive inflation is necessary to grease the wheels of the labour market. This argument, and a number of others in favour of small positive rates of inflation, are summarised here.

5.1 Inflation measurement bias

Measurement bias stems from the fact that the CPI measures the change over time in the cost of purchasing a fixed basket of goods and services, rather than the change in the minimum

cost to achieve a given standard of living (a cost of living index). Crawford, Fillion & Lafleche (1997) describe six sources of bias and present estimates of their magnitudes in the Canadian CPI.

- *Commodity-substitution bias*. This source of bias increases with the length of time between basket weight revisions and with the amount of variation in the relative prices of different goods and services.
- *Formula bias*. This arises from the use of arithmetic formulae for calculating price changes and can be eliminated by use of geometric rather than arithmetic means.
- *Quality bias*. This arises where a change in the quality of a product or service is not adequately taken into account when calculating the price change in that product or service. Although statisticians attempt to adjust for quality changes, it is difficult to fully adjust for such changes when calculating price changes. To the extent that quality improvements are not fully taken into account, the CPI will over-state the true rate of inflation. Conversely, to the extent that declines in quality are not fully reflected in the calculation of price changes, the CPI will under-state true inflation. Quality bias is the only type of bias that can be negative as well as positive.
- *Outlet-substitution bias*. This occurs when the survey methodology does not fully capture consumers' substitutions towards lower-priced stores.
- *New products bias*. The CPI will contain a positive bias if new products, such as electronic items, are excluded from the CPI basket during the early period of rapidly falling prices.
- *New brands bias*. This occurs as new brands come on to the market. Heckman (1995) estimated that ignoring new cereal brands in the United States would overstate cereal prices by 25 per cent.

Overall, Crawford *et al* (1997) estimate that measurement bias causes the Canadian CPI to over-state the true cost of

living change by around 0.5 per centage points per year. A much larger estimate was produced by the Boskin Commission (1997), which concluded that the United States CPI over-stated inflation by about 1.1 per centage points every year. The report found this bias was due to:

- Substitution bias: 0.4 per cent.
- New outlet bias: 0.1 per cent.
- Quality improvements or new products bias²³: 0.6 per cent. (Boskin report cited in Perloff (1998) p 143)

However, the United States Bureau of Labour Statistics (BLS) has argued that the Boskin Commission report over-states the extent of bias in the United States CPI and has rejected several of the quality and new goods biases as estimated by the Boskin Commission.²⁴

Although the Reserve Bank has not estimated CPI bias for New Zealand, the general view within the Bank has traditionally been that the bias in the New Zealand CPI would be closer to that in the Canadian CPI than to that in the United States CPI (Ebert, 1994, RBNZ 1996).

The relatively low estimates for New Zealand and Canada are generally attributed to methodological differences in constructing the price indices. In particular, Crawford et al estimated that commodity substitution bias in Canada is lower than in the United States, given basket weight updates every 4 years, compared to every 10 years in the United States. New Zealand formally updates basket weights every 3 years, although we understand that Statistics New Zealand takes a proactive approach to adjusting the weights, and so to some extent they re-visit the weights every quarter.^{25,26} A

former Government Statistician, Len Cook, has stated that his judgement was that the bias in the CPI was probably only half that in the United States. This would suggest an estimate of the bias for New Zealand of around 0.5 per centage points per annum.²⁷

More recently, Gibson and Scobie (2002) estimated the CPI bias for New Zealand to be about 1 per centage point per annum. Rather than estimate individual sources of bias and add them up, as did Crawford et al, Gibson and Scobie use the approach of Costa (2001) and Hamilton (2001) which involves the estimation of a food Engel's curve for different years of cross-section micro data.²⁸ However, as in the United States, there is considerable uncertainty around any one estimate.

As well as suggesting a slightly higher level of bias than Statistics New Zealand, Gibson and Scobie's results also show that the CPI bias varies over time. They state that the contribution of quality bias may be unusually large in the time period that they studied (1984 to 2001), due to the opening of the economy to new products, and new competitors from overseas.

Overall, the evidence suggests that the CPI measurement bias for New Zealand is most likely to lie within the range of 0.5 to 1.1 per centage points per annum, although we note that Statistics New Zealand would argue for the low end of this range. As table 4 indicates, the range of estimates for New Zealand is very similar to the range of estimates of the CPI bias in other countries.

As discussed in section 3.3, the available evidence suggests that trend deflation is something to be avoided. But it is unclear whether the negative effects of deflation would occur in the event of "true" deflation or only in the face of "measured" deflation. In other words, it is difficult to know

²³ Particularly new drugs and computers.

²⁴ See <http://stats.bls.gov/cpi/cpigm697.htm>.

²⁵ This is our understanding from informal discussions with Statistics NZ. For example, if Statistics NZ analysts observe that households are purchasing more DVD players, we understand that they would address this the next quarter, as opposed to waiting three years.

²⁶ Work completed by Peter Redward fails to find evidence of substitution bias in New Zealand (RBNZ, 1996, PC Docs 19652v1).

²⁷ See Cook (1996). Internal correspondence between the Reserve Bank and Statistics New Zealand also suggested that CPI bias was assumed to be in the region of around 0.5 per cent (RBNZ 1995, PC Docs 1586v1).

²⁸ Engel's law states that as the real income of a household rises, the proportion of income they spend on food falls. Therefore, after controlling for changes in relative prices and demographic changes, one would expect households at the same level of real income to spend the same proportion of their income on food consumption. If the share of food declines at the same time CPI-deflated incomes remain the same, then it is possible that the CPI has overstated the rise in prices. This would tend to suggest that the rise in real income was understated, implying an upward bias in the measurement of the CPI (Hamilton 2001).

Table 4
Estimated CPI bias in selected countries

Country	Bias (%)	Study
US	1.1	Boskin <i>et al</i> (1996) ²⁹
	0.6 – 1.5	Shapiro and Wilcox (1996)
	1.0	Hamilton (2001)
	0.6	Costa (2001)
Canada	0.5	Crawford (1993)
UK	0.35 – 0.8	Cunningham (1996)
NZ	0.7 – 1.1	Gibson and Scobie (2002)

how important the estimates of measurement bias are in practice for our choice of inflation target.

5.2 Downward rigidity in nominal wage rates

Real wage flexibility has an important role in facilitating the allocation of labour in the face of shocks to the economy. If a particular industry faces a sudden decrease in demand, and if there is inflation, then real wage decreases can be achieved with the nominal wage rate rising less rapidly than prices. Because reduced real wages allow firms in the industry to maintain employment, then such an adjustment process may break down in a low inflation regime if nominal wages are rigid downward – that is, if people are unwilling to accept a cut in their take-home pay packets.

A review of the academic literature produces relatively strong evidence that nominal wages do exhibit downward rigidity. But there is less agreement as to whether this actually matters for employment and growth, with the effects likely to vary considerably between countries and over time (eg depending on productivity growth rates).

Since labour market rigidities are one of the commonly cited reasons for targeting a positive (rather than zero) inflation rate, we spend some time discussing the two main questions in more detail: Do nominal wages exhibit downward rigidity? And does the downward rigidity exert a significantly negative impact on the real economy?

Do nominal wages exhibit downward rigidity?

A large amount of literature on nominal wage behaviour in the United States produces a general agreement that nominal wage rigidity is prevalent, but little consensus about the

extent of wage rigidity. This lack of consensus stems from debate about the relative merits of alternative data sources. In particular, a distinction can be drawn between studies based on surveys of individuals (such as the Panel Study of Income Dynamics (PSID)) and studies based on information drawn from employers' records. For a representative study, see Lebow, Saks and Wilson (1999), who find stronger evidence of downward nominal wage rigidity based on the United States employment cost index than do those studies that base their analysis on the PSID.

For New Zealand, we are aware of only two studies (Cassino (1995) and Chapple (1996)) that have investigated the nature and extent of downward wage rigidities. Both studies found a clear asymmetry in the distribution of wage changes, with a spike at zero, and relatively few instances of decreases in wage rates. Consistent with the United States results, the wage data from the New Zealand Labour Cost Index displayed greater skewness away from nominal wage cuts than did data taken from household surveys. Dwyer & Leong (2000) also find evidence of nominal wage rigidity for Australia over the 1987 to 1999 period.

While there is clear evidence that downward nominal wage rigidities do exist, wages are not the only way to cut unit labour costs. An effective real wage reduction could also be achieved by:

- Lowering the nominal wage for particular jobs at the point of employee changes/turnover.
- Not fully compensating employees for productivity gains/human capital development.

²⁹ Note that the BLS has made some post-Boskin modifications to the construction of the CPI and these changes have probably lowered measured inflation by around 0.5 percentage points. Thus the bias now is likely to be significantly less than the 1.1 per cent mentioned in the Boskin report.

- Increasing nominal remuneration on promotion by less than otherwise, or slowing the frequency of promotions.
- Reducing (or increasing at a slower rate) the non-wage components of total remuneration packages (especially variable compensation, such as bonuses).

Dwyer & Leong (2000) address the last of these concerns by using a broad measure of Australian remuneration.³⁰ They find that, while the distribution of changes in that broad measure is more dispersed than for wages, it is still quite positively skewed, suggesting that "total pay" is also inflexible downwards, but to a lesser extent than wages.³¹ However, they acknowledge that their analysis may not cover all ways in which employers may prevent downward nominal wage rigidity from adversely affecting their unit labour costs. In addition, they note that some of the observed nominal wage rigidity can probably be attributed to the self-selection evident in reported wage changes.³² Nevertheless, they conclude that the extent of rigidity they observe in Australia is sufficient to argue in favour of a small positive rate of inflation, rather than absolute price stability.

Using data for the United States, Lebow, Saks and Wilson (1999) also conclude that firms are able to circumvent part, but not all, of the nominal wage rigidities by varying benefits.

The existence of downward rigidity in nominal wages raises the question of why workers might accept declining real wages imposed by inflation, but not accept declining real wages imposed by nominal wage cuts. This phenomenon has traditionally been attributed to money wage illusion, a notion that economists are reluctant to incorporate into their models because it seems to presume that employees are irrational or easily fooled. However, Akerlof, Dickens and Perry (2000, ADP hereafter) provide a new interpretation on the role that inflation expectations play in price and wage setting. Essentially, ADP draw on the large body of

psychology literature that suggests people make decisions using simplified abstractions rather than the full information that is available to them. ADP thereby assume not that people are unable to form rational expectations of inflation, but rather that when inflation is low, people choose not to take it fully into account. As Alan Blinder puts it:

"A businessman who cannot keep infinite amounts of information in his head may worry about a few important things and ignore the rest. And when nation-wide inflation is low, it may be a good candidate for being ignored. Indeed, one prominent definition of 'price stability' is inflation so low that it ceases to be a factor in influencing decisions". (Blinder, Canetti, Lebow & Rudd (1998, cited in ADP, 2000)

This assumption has been criticised by a number of economists³³ who argue that the formation of inflation expectations may change in an environment of persistently low inflation.³⁴ Thus, ADP (2000) may be subject to the Lucas critique: once people become accustomed to very low persistent rates of inflation, they may become less willing to accept lower real wages over prolonged periods of time, and ADP's assumption may no longer be valid.

The following quote from the Reserve Bank's 1999 Briefing document suggests that the Reserve Bank has generally assumed that the formation of expectations will change as people adjust to a low inflation environment.

"As price stability becomes the common experience, nominal wages will probably become more flexible, downwards as well as upwards. That is, even if inflation below 2.5 per cent has been associated with constrained growth in the past, that is less likely to be the case today and in the future" (p.19).

Unfortunately, the literature to date has predominantly been concerned with measuring the extent of rigidities at alternative inflation rates, rather than with the question of how rigidities might change over time given a low inflation environment.

³⁰ It includes allowances, superannuation, loan benefits, company cars and costs incurred by the employer through fringe benefit tax.

³¹ One weakness of Dwyer and Leong's data set is that their 'broad' measure of remuneration excludes performance-based

³² That is, some wage offers (most likely those below the median) are not accepted and the employee quits, thus skewing the remaining distribution upwards.

³³ For example, Svensson (2001), Bank of Canada (2001).

³⁴ In addition, Svensson (2001) has argued that one of the objectives of monetary policy should be to help people to avoid monetary illusion and to make informed decision.

Other schools of thought offer alternative explanations for nominal wage rigidity. Some of these explanations include: the large returns to continuity of association between workers and firms; a presumption that workers care about relative wages;³⁵ and the role of minimum wage rates.

For the United States at least, the evidence using micro-data generally suggests that asymmetries in the setting of nominal wages are more prevalent at lower rates of inflation. Card & Hyslop (1997) use micro-level wage data³⁶ for the 1979-1993 period to show that the lower the rate of inflation, the higher the extent of the wage rigidity. Less conclusive evidence is produced by McLaughlin (1994, 1999) using PSID data over the 1971-1992 period, who finds evidence of inflation reducing the impact of nominal wage rigidity only for unionised and hourly wage workers. Lebow, Saks and Wilson (1999), using alternative tests for asymmetry, find relatively strong evidence that nominal wage rigidities are more prevalent in low inflation times.

For many European countries, there is also a consensus that the rate of inflation affects the distribution of nominal wage changes (Holden, 2002).

For New Zealand, Chapple (1996), using wage data from 1988 to 1995, provides some evidence that the skewness away from nominal wage cuts became more pronounced as inflation fell. A weakness of the Chapple study is that it is based predominantly on average wage data, rather than on the hourly cost of employing constant quality labour to perform a given job.³⁷ This raises the possibility that the data used may give false signals about wage flexibility. However, Dwyer & Leong (2000) using a superior data-set (for Australia) and a longer data sample of 1987 to 1999, also find that the degree of skewness rises as inflation falls.

³⁵ Tobin (1972) suggested that because workers care about relative wages in addition to absolute wages, workers rationally believe that inflation is more likely than nominal wage cuts to spread the pain across all workers equally.

³⁶ Card and Hyslop use data from both the Current Population Survey (CPS) and PSID.

³⁷ Unfortunately, the Labour Cost Index series for New Zealand (which is a constant-quality measure of labour costs) commences in the fourth quarter of 1992, which is after the achievement of price stability and therefore precludes analysis of how the relationship between inflation and nominal wage rigidity has evolved.

Does downward rigidity exert a significantly negative impact on the real economy?

In principle, if low inflation exacerbates the existence of downward nominal wage rigidities, then the rate of adjustment to negative shocks should be faster when inflation is higher. This is the rationale for the argument by some researchers, most famously Tobin (1972) and ADP (1996, 2000), that a little bit of inflation can grease the wheels of the labour market and result in a significant trade-off between inflation and unemployment, even in the long run.

However, despite reasonably robust evidence of nominal wage rigidities, there is little agreement about whether these rigidities do, in fact, adversely impact the real economy.

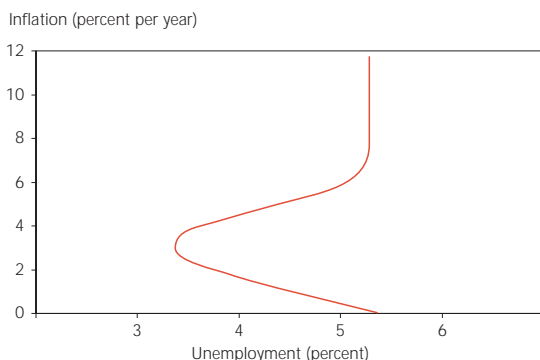
On the one hand, ADP (2000) argue that these rigidities do have significant employment effects, with their results stemming from the premise that people do not take inflation into account in a fully rational way. Having said that, ADP also agree with the conventional finding that there is no trade-off between inflation and growth at moderate rates of inflation. This is because, if inflation increases sufficiently, then the costs of being less than perfectly rational about inflation also rise, and people will then change their behaviour to take inflation into account.

When inflation is very low, however, "near-rational" wage and price-setters under-weight inflation relative to behaviour assumed in hyper-rational models. The fraction of inflation that is ignored fails to enter the inflation-augmentation term in the Phillips Curve. ADP then proceed to estimate an array of alternative specifications of their model using non-linear least squares and US data from 1954 to 1999. The vast majority of specifications suggest that significant gains in employment are possible by increasing inflation from zero to a rate above 1.5 per cent. Out of 218 specifications, only 12 produce an estimated optimal rate of inflation that is less than 1 per cent. Most specifications suggest that the optimal rate of inflation is around 2 to 3 per cent. Note, however, that ADP's concept of the optimal rate of inflation is based solely on their labour market analysis and ignores many of the other factors (discussed elsewhere in this paper) that should be taken into account in determining an optimal inflation target.

ADP use their model to derive a long-run Phillips Curve where actual and expected inflation coincide. Figure 2 portrays the non-linear long-run Phillips Curve that ADP obtain using benchmark parameters.³⁸ Unemployment is close to the natural rate at both very high and very low rates of inflation. At low positive rates of inflation the unemployment rate is below the natural rate.³⁹

The specification shown in figure 2 suggests that an inflation rate of around 2 to 3 per cent would be associated with the lowest rate of sustainable unemployment. However, there are a number of reasons why these results should not be taken at face value. First, as mentioned above, ADP do not evaluate whether this "grease" effect of inflation outweighs the "sand" effects that may depress output and employment. If the costs of inflation ("sand effects") were taken into account, the true optimal point would be one with lower inflation and higher unemployment than the left-most point in figure 2.

Figure 2
ADP's hypothetical long-run Phillips Curve



Source: Akerlof, Dickens & Perry's (2000) calculations from calibration of their theoretical model.

³⁸ In the benchmark case they assume that at least half of all firms are always fully rational. In contrast, the 'near-rational' firms are assumed to completely ignore inflation, but only at low rates of inflation. 95 per cent of firms are fully rational by the time inflation is 5 per cent.

³⁹ Note that the Phillips curve suggested by ADP (2000) is quite different from that produced by ADP (1996). ADP's 1996 model, which assumed a zero floor on nominal wage increases, produced a Phillips curve which suggested extremely high unemployment rates at low inflation rates. In contrast, ADP (2000) allows negative wage adjustments but assumes limited money illusion at low inflation rates. Most economists agree that the long-run Phillips curve produced by the more recent model (and reproduced in figure 2) is more consistent with US data than was the earlier model.

Second, the empirical analysis in the paper relies on data with inflation higher than 2 to 3 per cent, raising questions about the robustness of the results for lower rates of inflation.

Third, as mentioned above, and emphasised by Svensson (2001), the authors disregard the possibility that the formation of inflation and wage expectations may change under a transparent and credible low inflation policy.

Finally, while ADP's analysis suggests that a slightly higher than zero inflation target may result in a lower rate of unemployment, this does not necessarily imply higher rates of GDP growth, except during the transition to the lower unemployment state.

Concerns about the applicability of ADP (2000) are supported by the fact that most other United States studies suggest that downward nominal wage rigidities have only a very minor impact on the real economy. For example, although Card and Hyslop (1997) find evidence that downward rigidity increases as inflation falls, their analysis using macro data is less conclusive. Using state-level data on average real wages from 1976 to 1991, they find only weak evidence that wages adjust faster to negative shocks when inflation is higher. As a result, they conclude that the overall impact of nominal wage rigidities on the macroeconomy is probably only modest.⁴⁰

Similarly, United States Federal Reserve economists Lebow, Saks and Wilson (1999), also draw attention to what they label the "micro-macro puzzle": why does the wage rigidity at the micro level (as discussed above) not always appear to affect the macroeconomic relationship between aggregate inflation and the unemployment rate? In contrast with their micro-data analysis, their macroeconomic analysis leads them to the following conclusion:

"If downward nominal wage rigidity has any macroeconomic effects they are likely to be more complicated than is commonly depicted. It is possible that rigidity has significant effects on aggregate

⁴⁰ One reason for the lack of evidence that nominal rigidities adversely affect the real economy is simply that the impact may just be very difficult to precisely measure. For example, Card and Hyslop's point estimates imply that inflation does help to "grease the wheels", but these point estimates are imprecisely estimated so that the null hypotheses of 'no effect' or 'quite strong effects' cannot be rejected.

unemployment that have been masked by other factors. It is also possible that rigidity has had no effect on aggregate unemployment because firms have made other adjustments that could be reflected in other macroeconomic variables such as profits or productivity. Clearly, understanding the macroeconomic effects of downward nominal wage rigidity remains an important question for future research."

The relationship between nominal wage rigidities and the real economy has also been addressed by a number of Canadian economists, producing a similar lack of consensus to that in the United States literature. Simpson, Cameron and Hum (1998) and Fortin and Dumont (2000) both claim that a moderate rate of inflation is necessary to facilitate the adjustment of real wages and thereby minimise the employment losses that might stem from a floor on nominal wage changes. However, Bank of Canada researchers Faruqi (2000) and Fares and Hogan (2000) have extended the work of Simpson, Cameron and Hum (1998), using specifications that they claim more adequately control for other impacts on employment. On this basis, they conclude that downward nominal wage rigidity in Canada has had insignificant impacts on Canadian employment. Other Canadian research has also cast doubt on the role of nominal wage rigidity in affecting aggregate employment (e.g. Fares and Lemieux (2001)).

A slightly different approach is taken by Groshen and Schweitzer (1997), who find evidence of both grease and sand effects in the United States labour market. The grease effects have been well explained above. The sand effects arise when general inflation is not transmitted evenly or immediately to all wages because of menu costs or staggered labour contracts. They find that, for inflation rates of less than five per cent, the grease effects outweigh the sand effects (although this difference is not statistically significant). For inflation rates greater than five per cent, the sand effects outweigh the grease effects (and this difference is statistically significant). Groshen and Schweitzer also find that the net benefits are always less than one tenth of gross benefits, suggesting that the costs of inflation are significant even at low rates of inflation.

The majority of the literature discussed above is for the United States economy, and we are not aware of any New Zealand

literature that has addressed the relationship between nominal wage rigidities and employment. However, there are several reasons why the economic importance of nominal rigidities might vary across countries.

First, institutional labour market frameworks vary substantially around the world. Holden (2002) finds that the typical European economy, with high coverage of collective agreements and some employment protection legislation, requires a higher rate of inflation (than in the United States) to avoid additional unemployment. Wyplosz (2000) also suggests a relatively higher inflation target for Europe, although his results are based on Phillips curve estimates for European countries with relatively few observations of very low inflation.⁴¹ Similarly, Dickens (2000) applies the ADP (2000) methodology to Canada, the United Kingdom, France and Germany, and also finds that the optimal rate of inflation is higher for Europe than for Canada and the United States. He attributes this to lower labour mobility in Europe.

Second, while moderate rates of inflation may mitigate the adverse effects of downward rigidities, so does rapid productivity growth. Strong productivity growth in the United States may, therefore, help to explain why some studies have found little adverse economic impact from downwardly rigid wages. Holden (2002) concludes that a country with low productivity growth may need to target an inflation rate significantly higher than 2 per cent. On the other hand, a country with weak employment protection legislation, low unionisation and strong productivity growth may be able to target inflation rates of as low as zero per cent without adverse implications for employment.

Finally, there may be other forms of flexibility, besides wage flexibility, that will assist labour markets in adjusting to shocks. One possibility is inter-regional migration. For example, Choy, Mare and Mawson (2002) found that inter-regional migration played an important role in the response of New Zealand regions to region-specific shocks. Another way of achieving labour market flexibility is by adjusting employees' hours in the face of shocks. Such flexibility may have become more

⁴¹ **In commenting on Wyplosz, Svensson (2001) highlights the econometric problems with that paper, and draws on a range of research to conclude that there is no reason to believe that mid-point targets in the range of 1.5 – 2.5 per cent would provide difficulties for European inflation.**

important in New Zealand since the labour market reforms of the early 1990s.

In conclusion, there seems to be a consensus in the literature that nominal wages are rigid downwards, and tentative evidence that variations in non-wage remuneration will only partly offset the effects of wage rigidity. There is more mixed evidence regarding the extent to which the remaining nominal frictions will lead to sub-optimal macroeconomic outcomes. Overall, we conclude that it is possible that a very low inflation rate, in combination with wage rates that are downwardly rigid, could magnify nominal wage rigidities sufficiently to cause aggregate employment effects, although to date, there is little evidence suggesting that this is in fact the case.

There is significantly less academic literature on the topic of whether nominal rigidities in the goods and services markets may have similar effects to rigidities in the labour market. Goods and services prices are generally thought to be quite flexible, particularly in economies with competitive and contestable markets and low levels of import protection. Inflation may, of course, have played a more important role in facilitating real relative price changes in the past, when there were more price controls, and when competitive forces were weaker, than is the case today.

Of course, some of the sand effects of inflation – particularly menu costs - may be relevant for goods prices. However, there is some tentative evidence that relative price rigidities may fall when inflation is lower (Buckle and Carlson (1996)). This result is consistent with Ball and Mankiw's (1994) theoretical menu cost model, which predicts that the asymmetry in price adjustments disappears as inflation falls.

Overall, we conclude that it is not possible to quantify all the sand and grease effects of inflation, and it is not therefore possible to identify from the bottom up the optimal inflation target, where the sand effects fully counterbalance the grease effects. It is likely that the "optimal" rate of inflation, if one exists, would vary from country to country, and over time, as a function of many aspects of regulatory policy and institutional frameworks. For example, the relationship between inflation and employment will depend on labour productivity growth and the extent to which the institutional labour market framework allows nominal wage flexibility in

response to adverse shocks. Generally speaking, the New Zealand labour market is often characterised as more flexible than labour markets in Europe, but less flexible than labour markets in the United States.

5.3 Avoiding deflation and the "zero bound" on nominal interest rates

Deflation was a non-issue in the 1970s and 1980s. Since then, many countries have stabilised inflation at low rates of inflation, with Japan slipping into an alarming deflationary recession during the past decade, leading to increased concerns about the risk of deflation. Deflation is harmful for many of the reasons that inflation is harmful - such as menu costs and search costs⁴² - and because of problems specific to deflation, such as liquidity traps and deflationary spirals.

Broadly speaking, deflationary spirals feature persistently falling prices and depressed economic activity. There is some debate as to the causality involved when low growth and deflation coexist.

Three reasons are proposed as to why deflation may cause low growth:

- Contractionary redistributive effects of deflation in a debt-deflation scenario.
- Expected price falls result in deferrals of demand, and thus production.
- Nominal interest rates are bounded at zero, so that with sufficiently large deflation, real interest rates can be contractionary.

The first of these, the debt-deflation hypothesis, was set out by Fisher (1934) to explain the Great Depression. (The price level, measured by consumer prices, in the United States fell by approximately 25 per cent between 1929 and 1933, while

⁴² In an inflationary environment, the staggering of frequent price changes causes the relative prices of related goods to change regularly. This provides an incentive for consumers to search around for a product whose relative price is low because it has not been repriced recently. Such search involves real costs in time and effort that would be less common in an environment of general price stability. A deflationary environment is analogous, except that people are searching for goods whose prices have just been cut. The search costs involved are likely to be similar.

in New Zealand it fell by around 21 per cent). The essence of Fisher's argument is that deflation redistributes wealth from borrowers to lenders as the real value of a debt rises with deflation. If lenders have a lower marginal propensity to consume out of wealth than borrowers, this redistribution lowers overall consumption spending. In addition, deflation can promote financial instability by increasing the indebtedness of firms and reducing bank lending and hence investment – via moral hazard and adverse selection problems (see Mishkin (1991, 1997)).

The second argument is that if people expect prices to fall generally, then they are likely to defer some of their spending.⁴³ If deflation is widely expected, then the fall in demand could result in production being curtailed and the economy moving into a recession.

The final argument stems from the fact that nominal interest rates are bounded at zero (ie nominal interest rates cannot fall below zero). Thus a material deflation will lead to contractionary real interest rates; that is, real interest rates will be positive even if nominal interest rates are at zero. Summers (1991) analysed the post-war United States data and found that real interest rates were negative about one third of the time. He presented this as evidence that the ability to engender negative real interest rates is important. Hence, targeting a positive rate of inflation may help the central bank to avoid the potential problem of hitting the zero bound on nominal interest rates and ending up with positive real interest rates in a deflationary period.

Whereas the arguments above suggest that deflation can cause an economy to falter, the reverse causality is also plausible. The economy could be subject to a negative shock that causes production to fall. To the extent that producers cut prices to retain business, deflation would then eventuate. In this scenario deflation and a weak economy go together, but the recession is not due to the deflation. Both are caused by a third factor.

If the causation sometimes runs from a negative shock to weak output and then deflation, rather than from deflation to weak output, we might expect to be able to find examples

of deflation associated with steady growth. However, such episodes are rare.

The most extreme implication of the zero bound on nominal interest rates is the possibility that the economy could enter a "liquidity trap", in which the economy is satiated with liquidity and the nominal interest rate is zero. According to the Fisher equation, expected inflation equals the nominal interest rate minus the real interest rate. Therefore, if the nominal interest rate is zero, people would expect deflation, and in the steady state actual and expected deflation coincide (Amirault and O'Reilly 2001). The risk in this situation is that monetary policy may become ineffective at stimulating the economy.

A number of economists have recently used models to assess the implications of a zero bound on nominal interest rates for alternative inflation targets. They typically conclude that some small positive rate of inflation should be targeted, although we question the applicability of this result for New Zealand. Here we provide a brief review of these studies.⁴⁴

Fuhrer and Madigan (1997) use a model with a backward looking IS curve, overlapping price contracts, and a monetary policy reaction function to assess the implications of a zero bound on nominal interest rates. They derive the shocks to the IS equation in the model and then estimate the effects of these shocks given a range of inflation targets from 0 to 4 per cent. Orphanides and Wieland (1998) develop a similar model, in which they compare output variability under different inflation targets. Both of these papers find a significant detrimental effect on economic performance arising from the zero bound on nominal interest rate if a central bank targets an inflation rate of equal to or less than 1 per cent. They found that monetary policy was constrained and output more volatile under such low inflation targets, compared to more moderate targets of 2 to 3 per cent.

Cozier and Lavoie (1994) look at the issue from a different perspective. They use a calibrated approach with a small macro model, which includes aggregate demand, an expectations-augmented Phillips curve, a nominal exchange rate equation and a forward-looking monetary policy rule. Monetary policy is determined according to inflation

⁴³ This argument assumes that people's disposable income is not falling by as much as prices.

⁴⁴ For a more comprehensive review of the literature refer to Amirault and O'Reilly (2001).

targeting. Using stochastic exogenous shocks and applying them to five different inflation target scenarios, from zero to 4 per cent, they find that, as the inflation target approaches zero, the probability increases of hitting the zero bound and falling into a liquidity trap. However, they conclude that Canada's inflation target range of 1 to 3 per cent is sufficiently high to not cause any concerns.

The International Monetary Fund (IMF) (2002) has also argued that a low inflation target raises the possibility of a typical economy falling into a liquidity trap. They recommend that the monetary authority aim for an inflation rate of at least 2 per cent so that inflation is less likely to go significantly below zero. However, for the reasons discussed below, we argue that this work would have only weak implications for New Zealand.

Finally, while the IMF's view is based on simulations of a macro model, others have estimated empirical relationships from actual data. Engelbrecht and Langley (2001) analyse deflation crises, looking at economic growth before, during, and after a period of deflation. They find that economic growth tends to be much lower during periods of deflation than either before or after deflation. Unfortunately, little other research has examined the effect of deflation on growth, and some of the general studies of the growth-inflation relationship omit deflation observations altogether. This makes it difficult to assess the effects of deflation on growth.

Similarly, in the New Zealand context, Greasley and Oxley (2001) also associate deflation with negative growth effects. While Fisher (1934) tries to explain the cause of Great Depressions in many industrial countries in the 1930s, Greasley and Oxley try to explain how the Great Depression was conquered in New Zealand. They argue that the formation of the Reserve Bank of New Zealand in 1934 led to the end of a long deflation and that the change from generally falling prices to generally rising prices was a key reason for the increase in economic activity that ended the Great Depression in New Zealand.

Does New Zealand need to worry about hitting the zero nominal interest rate bound?

There is little empirical data with which to quantify the risks of being caught in a deflationary trap. But based on the theoretical arguments, we would contend that the risks to New Zealand are low.

Conceptually, Vinals (2000) has argued that several preconditions determine the risk and severity of a zero-bound nominal interest rate problem. Those conditions are:

- Low average inflation.
- A prevalence of large and/or persistent deflationary shocks.
- A low equilibrium short-term real interest rate.
- Limited non-interest rate channels through which monetary policy can influence the economy.⁴⁵

This suggests that, in the case of New Zealand, the risk of a deflationary recession, such as that in Japan, is reduced by two factors. First we have a relatively high equilibrium or "neutral" real interest rate (see Archibald and Hunter (2001)).⁴⁶ The higher neutral rate implies a higher nominal interest rate, which reduces the probability of the nominal interest rate falling as low as zero. This point is reinforced by the fact that the lowest short-term nominal interest rate that New Zealand has experienced in the last 20 years or so is around 4.5 per cent.

Second, New Zealand is a small open economy with a relatively strong exchange rate channel.⁴⁷ This provides an important non-interest rate channel through which monetary policy can influence the economy. For example, Svensson (2000) has proposed what he describes as a "foolproof" method for extracting an economy from a deflationary liquidity trap. His proposal involves the combination of

⁴⁵ This would be a particularly important issue for New Zealand if we joined a currency union that implied the loss of the exchange rate channel.

⁴⁶ Although the reasons for our relatively high neutral rate are poorly understood, it is probably related to a New-Zealand-specific risk premium and a significant appetite for debt.

⁴⁷ Hampton (2001) documents the significant relationship between import prices and consumer prices in New Zealand.

exchange rate depreciation and an increasing price level target to raise inflation expectations. The fact that the New Zealand economy is relatively open suggests that this approach could be significantly more effective for New Zealand than for a country like Japan. However, Svensson's proposal is controversial, with some economists (particularly those at the Bank of Japan) having argued that if monetary policy cannot affect the exchange rate risk premium, then when the nominal interest rate hits the zero bound, there may be no mechanism for expansionary monetary policy to cause the currency to depreciate.⁴⁸

Another consideration, regardless of the effectiveness of other channels for stimulating inflation, is that deflationary episodes may be operationally difficult to manage (see Mishkin (2001)). Once interest rates hit a floor of zero, most of the usual guides to conducting monetary policy are no longer relevant, leaving central bankers in uncharted territory. In addition, too low a target may result in the central bank being *perceived* as overly obsessed with controlling inflation, even if there is no strong economic rationale for such perceptions.

Finally, it is important to distinguish between trend and temporary deflations. The negative effects of deflation on growth postulated above are unlikely to be observed unless deflation is sufficiently large and sustained. If prices fall once, but then remain stable (or revert to a low inflation path), the adverse effects of deflationary expectations would most likely not emerge. Furthermore, such temporary deflation would have only a small impact on nominal debt, suggesting that debt-deflation problems would not be likely to emerge. However, if deflation is significant and sustained, then expectations of further price falls will influence spending patterns and debt holders will find their liabilities increasing in real terms. Therefore, we should guard against allowing prices to fall persistently, but should not necessarily be unduly concerned by occasional price level falls.

In summary, sustained deflation can be regarded as a low probability but potentially high cost event. We have argued that New Zealand is much less likely than many other countries to encounter the zero bound on nominal interest

rates – primarily because of our high neutral interest rates. In turn, this means that deflationary concerns provide little reason for New Zealand to bias the choice of inflation target upwards. However, there may be other reasons not to include zero within the target range. For example, a very low inflation target may increase the risks of the Reserve Bank being perceived as excessively zealous in its approach to controlling inflation.

6 Conclusion

New Zealand's original inflation target of 0 to 2 per cent, first announced in the late 1980s, began primarily as a device to influence public expectations and strengthen the commitment to achieving price stability. The 1996 widening of the band to 0 to 3 per cent was consistent with the view that a small positive rate of "true" inflation would be preferable to a small negative rate of inflation. But over time, as the popularity of inflation targeting has grown, the volume of academic literature evaluating what might be an optimal target has also grown. The purpose of this paper has been to review that literature, with a view to reassessing the Reserve Bank's current inflation target.

The literature presents clear evidence that both persistent deflation and high rates of inflation are associated with poor economic performance. The literature comes to no firm view as to what level of inflation qualifies as being "high". But, for industrial countries at least, there is increasing evidence that the "threshold" at which inflation has negative consequences for growth may be around 3 per cent inflation.

At low rates of inflation – that is, below the threshold – the majority of studies find no correlation between inflation and growth. As a result, most economists have concluded that it would be difficult to distinguish between alternative average inflation rates in the range of around 1 to 3 per cent. One per cent is typically chosen as a lower bound, not because there is robust evidence to suggest that average inflation rates between 0 and 1 per cent are detrimental to growth, but rather for political economy reasons, and in recognition of the increased risks of persistent deflation when inflation is very low.

⁴⁸ Other solutions to the zero bound problem have also been suggested (e.g. Orphanides and Wieland (1998)).

There are a couple of reasons why the macroeconomic literature may have found it difficult to precisely identify the relationship between low rates of inflation and growth. First, there are relatively few low inflation observations from long-term credible low inflation regimes, which makes it difficult to draw conclusions on the basis of the empirical research that has been conducted to date. Future research may be able to shed more light on the relationship between inflation and growth at very low rates of inflation.

Second, it is likely that the "optimal" rate of inflation, if one exists, would vary across countries and over time, as a function of many aspects of broader economic policy and institutional frameworks. Drawing on the microeconomic literature, there are some general rules of thumb that could be applied to New Zealand:

- New Zealand's exchange rate channel and relatively high neutral real interest rate suggest that New Zealand has less reason to fear a liquidity trap or hitting the zero bound on nominal interest rates than do other countries.
- New Zealand's tax system is often considered relatively less distortionary than the United States tax regime. All else being equal, this would suggest that the cost of inflation may be relatively lower for New Zealand than for the United States.
- The less flexible a country's labour market institutions, the greater the grease benefits of small positive rates of inflation. Broadly speaking, New Zealand's labour market is characterised as being less flexible than in the United States, but more flexible than those in Australia and many European countries.
- The grease benefits of inflation may also be greater for countries with relatively low labour productivity growth, such as New Zealand.

Of course, to the extent that the inflation distortions in section 4.2 stem from the interaction between taxes and inflation, rather than stemming from inflation alone, it is unclear a priori whether monetary or fiscal policy (or structural policy) is best suited to minimising these inefficiencies. Likewise, rigidities in the labour market might be better addressed through specific institutional arrangements in the labour

market. However, this paper takes these institutional frameworks as given.

Overall, we conclude that the economic literature is unable to distinguish between the implications for economic growth of average inflation outcomes of 1.5 per cent, 2 per cent and 2.5 per cent.

References

- Aiyagari, S R (1990), "Deflating the case for zero inflation", *Federal Reserve of Minneapolis Quarterly Review*, summer.
- Akerlof G, W Dickens, and G Perry (1996), "The macroeconomics of low inflation", *Brookings Papers on Economic Activity* 1:1996, pp 1-76.
- Akerlof, G, W Dickens and G Perry (2000), "Near-rational wage and price setting and the optimal rates of inflation and unemployment", *Brookings Papers on Economic Activity*, 1:2000, pp 1-60.
- Akerlof, G and J Yellen (1985), "A near-rational model of the business cycle, with wage and price inertia" in Mankiw, G and Romer, D (1991) *New Keynesian Economics*, MIT Press.
- Altonji, J G and P J Devereaux (1999), "The extent and consequences of downward nominal wage rigidity", *NBER Working Paper* No 7236.
- Ambler, S and E Cardia (1997), "Testing the link between inflation and growth", A paper prepared for Bank of Canada conference on *Price Stability, Inflation Targets and Monetary Policy*, May 1997.
- Amirault, D and B O'Reilly (2001), "The zero bound on nominal interest rates: How important is it?" *Bank of Canada Working Paper* 2001-6.
- Andres J, and I Hernando (1997), "Does inflation harm economic growth: Evidence for the OECD", *NBER Working Paper* No 6062.
- Bakhshi, H, A G Haldane and N Hatch (1998), "Some costs and benefits of price stability in the United Kingdom", *NBER Working Paper* No 6660.
- Ball, L and D Romer (1989), "Are prices too sticky?" *Quarterly Journal of Economics*, 104(3).

- Ball, L and G Mankiw (1994), "Asymmetric price adjustment and economic fluctuations", *Economic Journal*, Vol. 104.
- Bank of Canada Technical Background Document 1 (2001), "A brief review of the literature on whether a low inflation environment leads to economic difficulties".
- Barnes, M (2001), "Threshold relationships among inflation, financial market development and growth", University of Adelaide, mimeo.
- Barro, R and X Sala-i-Martin (1991), "Convergence across states and regions", *Brookings Papers on Economic Activity*, 0: 1991, pp 107-58.
- Barro, R and X Sala-i-Martin (1999), "Economic Growth", McGraw Hill.
- Barro, R (1995), "Inflation and economic growth", *NBER Working Paper* No 5326.
- Bernanke, B and F Mishkin (1997), "Inflation targeting: a new framework for monetary policy?", *Journal of Economic Perspectives* 11, pp 97-116.
- Black, R, D Coletti and S Monnier (1997), "On the costs and benefits of price stability", A paper prepared for Bank of Canada conference on *Price Stability, Inflation Targets and Monetary Policy*, May 1997.
- Blanchard, O (1998), "Macroeconomics", Prentice Hall.
- Blanchard, O and N Kiyotaki (1987), "Monopolistic competition and aggregate demand" in Mankiw, G and D Romer (eds.) (1991), *New Keynesian Economics*, MIT Press.
- Blinder, A (1999), "Central Banking in Theory and Practice", MIT Press, MA, USA.
- Bonato, L and B White (1997), "Some estimates of the welfare costs of inflation", Reserve Bank of New Zealand Memorandum for the Monetary Policy Committee, 26 August, 1997, Ref #49408.
- Bonato, L (1998), "Price stability: some costs and benefits in New Zealand", *Reserve Bank of New Zealand Discussion Paper*, G98/10.
- Boskin, M J (1997), "Toward a more accurate measure of the cost of living: final report to the senate finances committee from the advisory commission to study the consumer price index.
- Brunner, K and A H Meltzer (1981), "The costs and consequences of inflation", *Carnegie-Rochester Conference Series on Public Policy* X, YY-YY.
- Bruno, M and W Easterly (1995), "Inflation crises and long-run growth", *NBER Working Paper* No 5209.
- Buckle, R A and J A Carlson (1996), "Inflation and asymmetric price adjustment", *GSBGM Working Paper Series* 12/96, Victoria University of Wellington Printers.
- Burdekin, R, A Denzau, M W Keil, T Sitthiyot and T Willett (2000), "When does inflation hurt growth? Different nonlinearities for different economies", *Claremont Colleges Working Paper* 2000-22.
- Bureau of Labour Statistics, <http://stats.bls.gov/cpi/cpigm.htm>.
- Card, D and D Hyslop (1997), "Does inflation 'grease the wheels of the labor market?'" in Romer, C and D Romer (eds.), *Reducing Inflation*, The University of Chicago Press.
- Carey, D (1989), "Inflation and the tax system", *Reserve Bank of New Zealand Bulletin*, Vol 52, pp 18-26.
- Cassino, V (1994), "Menu costs: a literature survey", *Reserve Bank of New Zealand Discussion Paper*, G95/6.
- Cassino, V (1995), "The distributions of price and wage changes in New Zealand", *Reserve Bank of New Zealand Discussion Paper* G95/6.
- Chapple, S (1996), "Money wage rigidity in New Zealand", *Labour Market Bulletin* 96, 23-50.
- Choy, W K, D Mare and P Mawson (2002), "Modelling regional labour market adjustments in New Zealand", *Treasury Working Paper*, 02/01.
- Christoffersen, P and P Doyle (1998), "From inflation to growth: eight years of growth", *IMF Working Paper*, 98/99.
- Clarida, R, J Gali and M Gertler (1999), "The science of monetary policy: a New Keynesian perspective", *Journal of Economic Literature* 37, pp 116-1707.
- Coletti, D and B O'Reilly (1998), "Lower inflation: benefits and costs", *Bank of Canada Review*, Autumn: 3-21.
- Cook, L (1996), "Government statistician on inflation measure", Transcript of interview with Len Cook on National Radio Morning Report, 5 June 1996, 7:18am.

- Cooley, T and G D Hansen (1991), "The welfare costs of moderate inflations", *Journal of Money, Credit and Banking* 23.
- Costa, D (2001), "Estimating real income in the United States from 1888 to 1994: correcting CPI bias using Engel curves", *Journal of Political Economy* 109, pp. 1288-1310.
- Cozier, B and C Lavoie (1994), "Is there a floor to nominal interest rates? Evidence and implications for the conduct of monetary policy", Calgary University, mimeo.
- Crawford A, J-F Fillion, and T Lafleche (1997), "Is the CPI a suitable measure for defining price stability?", in *Price Stability, Inflation Targets, and Monetary Policy: Proceedings of a conference held by the Bank of Canada*, May 1997.
- Cunningham, A (1996), "Measurement bias in price indices: An application to the UK's RPI", *Bank of England Working Paper*, No 47, March.
- Davis, G and B Kanago (2000), "The level and uncertainty of inflation: results from OECD forecasts", *Economic Inquiry* 38, pp 58-72.
- Dickens, W T (2000), Comments on Charles Wyplosz's "Do we know how low inflation should be?" A paper presented at the First European Central Banking Conference, Frankfurt, Germany, November 2 – 5, 2000.
- Dolado, J J, J M Gonzalez-Paramo and J Vinals (1997), "A cost-benefit analysis of going from low inflation to price stability", *Banco de Espana Documento de Trabajo* No. 9728.
- Dornbush, R and S Fischer (1993), "Moderate inflation", *World Bank Economic Review* 7, 1-44.
- Dupasquier, C and N Ricketts (1998), "Non-linearities in the output-inflation relationship: some empirical results for Canada", *Bank of Canada Working Paper* 98-14.
- Dwyer, J and K Leong (2000), "Nominal wage rigidity in Australia", *Reserve Bank of Australia Research Discussion Paper* 2000-08
- Ebert, C (1994), "Defining price stability: what should we aim for?", *Reserve Bank of New Zealand Bulletin*, Vol 57. No 1.
- Engelbrecht, H-J and C Langley (2001), "Inflation crises, deflation and growth: further evidence", *Applied Economics* 33, 1157-1165.
- Farès, J and S Hogan (2000), "The employment costs of downward nominal-wage rigidity", *Bank of Canada Working Paper* No. 2001-1.
- Farès, J and T Lemieux (2000), "Downward nominal-wage rigidity: A critical assessment and some new evidence for Canada", in *Price Stability and the Long-Run Target for Monetary Policy: Proceedings of a conference held by the Bank of Canada*, June 2000.
- Faruqui, U A (2000), "Employment effects of nominal-wage rigidity: An examination using wage-settlements data", *Bank of Canada Working Paper*, 2000-14.
- Feldstein, M (1996), "The costs and benefits of going from low inflation to price stability", *NBER Working Paper* No 5469
- Feldstein, M (1997a), "The costs and benefits of going from low inflation to price stability", in Romer, C and D Romer (eds), *Reducing Inflation*, The University of Chicago Press.
- Feldstein, M (1997b), "Capital income taxes and the benefit of price stability", *NBER Working Paper* No 6200.
- Filardo, A (1998), "New evidence on output costs of inflation" *Federal Reserve of Kansas City Economic Review* 83(3), 33-62.
- Fischer, S (1993), "The Role of Macroeconomic Factors in Growth", *Journal of Monetary Economics*, Vol. 32 pp 485-512
- Fisher, I (1934), "The debt-deflation theory of Great Depressions", *Econometrica* 2, 337-357.
- Fortin, P and K Dumont (2000), "The shape of the long-run Phillips Curve: Evidence from Canadian microdata, 1956-97", *Working Paper, Departement des sciences economiques, Universite du Quebec a Montreal* (June).
- Friedman, M (1969), "The optimum quantity of money", in *The Optimum Quantity of Money and Other Essays*, 1-50, Chicago: Aldine Publishing.
- Fuhrer, J, C and B Madigan (1997), "Monetary policy when interest rates are bounded at zero", *Review of Economics and Statistics* 79, pp 573-85.

- Ghosh, A and S Phillips (1998), "Warning: inflation may be harmful to your growth", *IMF Staff Papers* 45, pp 672-710.
- Gibson, J and G Scobie (2002), "Are we Growing Faster than we Think: An Estimate of 'CPI Bias' for New Zealand", New Zealand Economic Association Annual Conference, Wellington
- Gordon, R (1997), "The time varying NAIRU and its implications for economic policy", *Journal of Economic Perspectives* 11(1), pp 11-32.
- Greasley, D and L Oxley (2001), "Conquering the Great Depression: the unique New Zealand experience", New Zealand Association of Economists Conference Paper, June.
- Greville, R and M Reddell (1990), "The costs of inflation", *Reserve Bank of New Zealand Bulletin*, Vol 53, No 1.
- Grimes, A (1979), "Demand-shift inflation theory: A preliminary examination in the New Zealand context", *New Zealand Economic Papers* 13, 56-74.
- Grimes, A (1991), "The effects of inflation on growth: some international evidence", *Weltwirtschaftliches Archiv* 127, 631-644.
- Groshen, E L and M Schweitzer (1997), "Identifying inflation's grease and sand effects in the labour markets" in Feldstein, M. (ed.) *The Cost and Benefits of Price Stability*, Chicago, University of Chicago.
- Hamilton, B (2001), "Using Engel's Law to estimate CPI bias", *American Economic Review* 91(3), pp 619-630.
- Hampton, T (2001), "How much do import price shocks matter for consumer prices?", *Reserve Bank of New Zealand Discussion Paper* DP2002/06.
- Hargreaves, D (1997), "Wage rigidity, price stability and growth", *Reserve Bank Research Memorandum*, M97/10. Ref # 51110.
- Heckman, J (1995), "Valuation of new goods under perfect and imperfect competition", NBER Working Paper 4970.
- Holden, S (2002), "The costs of price stability – Downward nominal wage rigidity in Europe", *NBER Working Paper* No 8865.
- International Monetary Fund (2002), *World Economic Outlook*, April.
- Johnson, S (1993), "The Cost of Inflation Revisited", *Reserve Bank of New Zealand Bulletin*, Vol 56, March.
- Judson, R and A Orphanides (1996), "Inflation, volatility and growth", Board of Governors, Finance and Economics Discussion Series 96/19, published in *International Finance* 2(1): 117-138, April 1999.
- Khan, M and A Senhadji (2001), "Threshold effects in the relationship between inflation and growth", *IMF Staff Papers* 48(1), 1-21.
- Lebow, D E, Raven E Saks and B A Wilson (1999), "Downward nominal wage rigidity: Evidence from the employment cost index", *Federal Reserve System Finance and Economics Discussion Series* No 1999-31, Board of Governors of the Federal Reserve System.
- Lebow, D, D Stockton, and W Wascher (1994), "Inflation, nominal wage rigidity and the efficiency of labour markets", Washington DC, Division of Research and Statistics, Board of Governors of the Federal Reserve System.
- Levine, R and S Zeros (1993), "What have we learned about policy and growth from cross-country regressions?", *American Economic Review*, 83, May.
- Mankiw, G (1985), "Small menu costs and large business cycles" in Mankiw, G and D Romer (eds.) (1991), *New Keynesian Economics*, MIT Press.
- McLaughlin, K J (1994), "Rigid wages?" *Journal of Monetary Economics*, 34 (December), pp 383-414.
- McLaughlin, K J (1999), "Are nominal wage changes skewed away from wage cuts?" *Federal Reserve Bank of St Louis Review*, May/June 1999.
- Meyer, L H (2001), "Inflation targeting and inflation targets", *Federal Reserve Bank of St Louis Review* 83(6), 1-13.
- Mishkin, F and Schmidt-Hebbel, K (2001), "One decade of inflation targeting in the world: what do we know and what do we need to know", *NBER working paper* 8397.
- O'Reilly, B (1998), "The Benefits of Low Inflation: Taking Stock", Technical Report No 83, Ottawa: Bank of Canada.
- Orphanides, A, D Small, V Wieland, and D Wilcox (1997), "A quantitative exploration of the opportunistic approach to disinflation", Finance and Economics Discussion Series,

- 97-36, *Board of Governors of the Federal Reserve System, June*.
- Orphanides, A and D Wilcox (1996), "The opportunistic approach to disinflation", *Board of Governors Finance and Economics Discussion Paper* 96/24.
- Orphanides, A and V Wieland (2000), "Inflation zone targeting", *European Economic Review* 44, 1351-1387.
- Orphanides, A and V Wieland (1998), "Price stability and policy effectiveness when nominal Interest Rates are Bounded at Zero", *Federal Reserve Board Working Paper* 35, FRB, Washington.
- Perloff, J M (1998), "Microeconomics", Addison-Wesley, Policy Targets Agreement, 1999.
- Poole, W (1999), "Is inflation too low?" *Federal Reserve Bank of St Louis Review* 81(4), 3-10.
- Ragan, C (1998), "On the Believable Benefits of Low Inflation", *Bank of Canada Working Paper* No. 98-15.
- Reddell, M (1999), "Origins and early developments of the inflation target", *Reserve Bank of New Zealand Bulletin*, Vol 62(3).
- Redward, P (1996), "Substitution bias in consumer price index" *Reserve Bank of New Zealand Research memo*, PC Docs#19652v1.
- Reserve Bank of New Zealand (1987), "Briefing on the Reserve Bank of New Zealand".
- Reserve Bank of New Zealand (1990), "Briefing on the Reserve Bank of New Zealand".
- Reserve Bank of New Zealand (1996), "Briefing on the Reserve Bank of New Zealand".
- Reserve Bank of New Zealand (1996), "Measurement Bias in the CPI", Internal memo.
- Reserve Bank of New Zealand (1999), "Briefing on the Reserve Bank of New Zealand".
- Reserve Bank of New Zealand Memorandum to the Minister of Finance (1988a), "Inflation objectives and monetary policy" paper no. 2416, 13 April 1988.
- Reserve Bank of New Zealand Memorandum to the Minister of Finance (1988b), "Price stability and inflation targets" paper no. 2536, 15 July 1988.
- Reserve Bank of New Zealand Memorandum to the Minister of Finance (1988c), "Price stability and inflation targets" paper no. 2537, 15 July 1988.
- Sala-i Martin, X (1996), "Regional cohesion; evidence and theories of regional growth and convergence", *European Economic Review* 40, pp. 1325-1352.
- Sarel, M (1995), "Non-linear effects of inflation on economic growth", *IMF Working Paper* 95/96
- Schultz, C (1959), "Recent inflation in the United States", in Joint Economic Committee, *Study of Employment, Growth, and Price Levels*, "Study Paper No. 1", Washington DC, Government Printing Office, as reprinted in J. Lindauer (ed.) [1968], *Macroeconomic Readings*, New York: The Free Press.
- Shapiro, M and D Wilcox (1996), "Mismeasurement in the consumer price index: An Evaluation", *NBER Working Paper* 5590.
- Simpson, W, N Cameron and D Hum (1998), "Is hypoinflation good policy?" , *Canadian Public Policy*, 24, pp 291-308.
- Smith, J (2000), "Nominal wage rigidity in the United Kingdom", *The Economic Journal*, 110 (March), pp 176-195.
- Stiglitz, J (1997), "Reflections on the natural rate hypothesis", *Journal of Economic Perspectives* 11(1), pp 3-10.
- Summers, L (1991), "Panel Discussion: Price stability, how should long-term monetary policy be determined?" *Journal of Money, Credit and Banking* 23 (3), pp. 625-631.
- Svensson, L (2000), "The zero bound in an open economy: a foolproof way of escaping from a liquidity trap" *NBER Working Paper* #7957.
- Svensson, L (2001), "Do we know how low inflation should be?" Comments on Charles Wyplosz, <http://www.princeton.edu/~svensson/papers/cwecb.pdf>
- Temple, J (2000), "Inflation and growth", *Journal of Economic Surveys* 14(4), 395-426.

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Tobin, J (1972), "Inflation and Unemployment", *American Economic Review*, Vol 62, Issue 1/2, 1-18.

Todter, K-H and G Ziebarth (1997), "Price stability vs low inflation in Germany: an analysis of costs and benefits", *NBER Working Paper* No 6170.

Vinals, J (2000), "Monetary policy issues in a low inflation environment", in *Why price stability?* By Herrero, A G, Gaspar,

V, Hoogduin, L, Morgan, J, and B Winkler (eds.), First ECB Central Banking Conference, November 2000, Frankfurt, Germany.

Wylosz, C (2000), "Do we know how low inflation should be?" in *Why price stability?* By Herrero, A G, Gaspar, V, Hoogduin, L, Morgan, J, and B Winkler (eds.), First ECB Central Banking Conference, November 2000, Frankfurt, Germany.