Alternative measures of underlying inflation

This article, by Scott Roger, discusses the strengths and drawbacks associated with various methods of estimating underlying inflation. Using these different techniques, alternative estimates of underlying inflation in New Zealand are compared over the 1989-93 period, and directions for future research are indicated.

Summary

The Policy Targets Agreement specifies circumstances in which the official or 'headline' rate of inflation may be permitted to move outside the 0-2 percent target range. The Bank's measure of underlying inflation is based on these 'caveats'.

It is argued in the article that in addition to accurately measuring underlying inflation, it is also important that the measure be readily verifiable by independent agents and available on a timely basis. It is likely to be difficult to find a measure of underlying inflation that is ideal in all respects.

The article discusses four different techniques of estimating underlying inflation, including the Bank's current method, which relies mainly on 'specific adjustment'. The other methods are adjustment by systematic exclusion of volatile components of the CPI, a trimmed mean CPI and a weighted median measure of the CPI.

Using these different techniques, estimates of underlying inflation are constructed and compared for the 1989-93 period. All of the measures other than the CPI excluding food and fuel items indicate that, over the period, relative price movements have usually added to headline inflation, while interest costs in the CPI have mainly lowered inflation. These results point to the need for further research into the issue of why relative price shocks have appeared to be mainly inflation-boosting.

I Introduction

The Policy Targets Agreement (PTA)\(^1\) requires the Reserve Bank to target the 12-month rate of increase in the All Groups Consumer Price Index (CPI). At the same time, however, the PTA recognises that in a variety of circumstances it will be appropriate for the Reserve Bank to permit CPI inflation to move outside the 0-2 percent target range.

\(^1\) Dated 16 December 1992, and replacing the previous PTA dated 19 December 1990.

Reserve Bank Bulletin, Vol 57, No. 2 1994
Such ‘caveats’ may be justified on a number of grounds, but the most important is the notion that some price developments are most accurately described—and treated—as one-off shifts in the overall price level. This means that they will have only a temporary impact on the inflation rate. In such circumstances, a significant adjustment in the stance of monetary policy would be neither necessary nor appropriate. In contrast, price developments expected to affect the on-going rate of inflation would warrant a policy response. It is, therefore, important for monetary policy to be able to distinguish between these two kinds of price developments.\footnote{For a more detailed discussion, see Archer (1993).}

The ‘underlying’ rate of inflation may be thought of as the rate of inflation excluding such non-inflationary (or deflationary) price level developments and, therefore, the inflation rate which matters most in the setting of monetary policy. Distinguishing between temporary and on-going changes in the inflation rate, however, is more straightforward in theory than in practice. This article outlines four different methods—including the Reserve Bank’s current method—of estimating underlying inflation. Using the different methods, estimates of New Zealand’s underlying inflation rate over the past four years are compared. The article concludes with a discussion of issues requiring further research.

II The PTA and the definition of underlying inflation

As indicated above, the PTA identifies a variety of circumstances considered most likely to qualify for special treatment in the conduct of monetary policy (the ‘caveats’) and which, by implication, may be considered as prime candidates\footnote{It may be noted, however, that in referring to the ‘principal’ shocks, the PTA could reasonably be interpreted as providing an indicative rather than exhaustive list of the sorts of circumstances which may lead to an acceptable temporary movement of measured inflation outside the target range.} for exclusion from a measure of underlying inflation. These include (a) import or export price shocks significantly affecting the terms of trade; (b) significant indirect tax rate changes; (c) changes in government charges that significantly affect the price level; (d) perverse interest rate effects on the price level; (e) natural disasters likely to have significant price level effects.

Analytically, it is useful to think of these kinds of events or ‘shocks’ as falling into one or another of three basic categories:

1. **Generalised shifts in the price level.** As long as these sorts of price shocks are perceived as one-off events, they should not have any lasting effect on the inflation rate, in which case it would be inappropriate to modify monetary policy in response to the (temporary) increase in the measured inflation rate. Changes to the rate of the Goods and Services Tax (GST) and natural disasters would be most likely to fall into this category, both because of their irregular or infrequent occurrence, and because they would most likely affect the prices of a substantial number of goods and services in the CPI.

2. **Relative price shifts** that significantly affect the general price level. These types of price movement differ from generalised price shifts mainly in terms of the ‘breadth’ of the shock to prices. Changes in major import or export prices or

---

Reserve Bank Bulletin, Vol 57, No. 2 1994
changes in government charges are good examples of relative price movements affecting the general price level: a sharp adjustment in world oil prices or health charges may leave most prices in the CPI unaffected, but can nonetheless have a significant impact on the overall level of the CPI. Although movements in relative prices need not, in principle, lead to movements in the general price level, in practice there will tend to be price level effects. These are most likely to occur when there is a high degree of inertia or 'stickiness' in prices. As a result, a rise in world oil prices would not be offset—at least not quickly—by declines in other prices such that the overall CPI remained unchanged.

3. **Perverse effects of interest rates in the CPI.** The key argument for leaving direct interest rate effects out of the measure of underlying inflation is that if these were not removed they could lead monetary policy to over-react to movements in measured inflation. For example, a tightening of monetary policy to counter inflation pressures would tend to boost interest rates and the interest cost component of measured inflation. This would run the danger of provoking further policy tightening and so on. Eventually, the inflation dampening effects of policy tightening, including the effects that work indirectly through higher interest rates, would start to come through and the whole process would begin to reverse itself. The perverse direct effect of interest rate movements would thus tend to promote excessive movements in monetary conditions, generating unnecessary volatility in inflation and real economic conditions.

It is important to note, however, that events or shocks that move the price level can include a mixture of pure price level shifts and generalised inflation (or deflation), and that pure price level shifts can stimulate generalised inflation (or deflation), depending on the circumstances and the reaction of monetary policy. For this reason, even when accurately identified and measured, the origin and implications of price level shocks need to be assessed when determining the appropriate policy response. Accordingly, the PTA is permissive rather than directive in its specification of the caveats.4

This article leaves aside the question of the judgements that must be reached in determining the appropriate policy response to price shocks, and concentrates instead on measurement of underlying inflation in the presence of such shocks.

### III Desirable characteristics of an underlying inflation measure

Ideally, a measure of the underlying rate of inflation should have all of the following properties:

- It should distinguish accurately between price movements that represent ongoing inflation and those which are one-off movements in the price level.
- It should be available as soon as possible following the release of the official CPI

---

4 Archer (1993) discusses this point in more detail.

*Reserve Bank Bulletin, Vol 57, No. 2 1994*
and not be subject to revision or retrospective adjustment. In order for monetary policy to be set appropriately, a measure of underlying inflation that is perfectly accurate, but only available long after it is needed, is less useful than a measure slightly less perfect, but available when needed.

- It should be able to be readily verified or reproduced by an independent agent. This property could be important in maintaining policy credibility and accountability. If monetary policy is significantly influenced by an inflation measure that only the Reserve Bank itself can construct, the intended accountability of the Bank for its actions could be undermined. From this perspective, an underlying inflation measure that is perfectly accurate but difficult to replicate outside the Bank may not be preferable to a measure that is slightly less accurate, but easily replicated and verified by others.

It is probably too hopeful to expect that any single method of calculating underlying inflation will be superior to all others in every respect. As a result, some trading-off between different qualities is probable in choosing a ‘preferred’ measure of underlying inflation. An alternative is to use an array of different measures, but this itself may reduce policy accountability or transparency by muddying the link between changes in any particular measure of underlying inflation and monetary policy adjustments.

IV Alternative methods of measuring underlying inflation

In constructing an underlying inflation series, a variety of methods are available to purge the ‘raw’ All Groups CPI of shocks. In this section we consider the principal techniques that have been used either in New Zealand or abroad. As should be evident, the different methods of adjustment need not be regarded as mutually exclusive. Some mixing and matching is possible and, indeed, may be appropriate.

1. Specific adjustment

One approach to extracting an underlying measure of inflation from the published ‘headline’ rate is to purge the headline series of the estimated effects of specific types or sources of disturbances. Internationally, this method is commonly used to adjust for the effects of indirect tax changes (eg. in New Zealand and Canada) and, less commonly, the direct price effects of commodity price shocks (eg. in New Zealand).

In general, this method works quite well when there is a good deal of information available regarding the timing and magnitude of the shock effects on the price series concerned. With tax changes affecting consumer prices pretty directly, such as changes in GST rates, government charges, etc., the direct, first-round effect of the tax change on the CPI inflation rate can be calculated quite readily using the change in the tax rate (or proportional change in the levy) and the weight of the affected goods and services (or, if applicable, the weight of the taxed components).5

---

5 See, eg, Bank of Canada (1991b). The Bank of Canada notes in its discussion that the simple approach described implicitly takes the indirect tax regime applying in the base year as given. An alternative would be to strip out the effect of indirect taxes on base year weights. The former approach makes calculations relatively simple but may slightly overstate the price effects of tax changes and creates some problems when the base year weights are changed.

Reserve Bank Bulletin, Vol 57, No. 2 1994
The more indirectly that shocks feed into the price level, however, the more difficult it is to make specific adjustments. With shocks to the prices of intermediate inputs to production, for example, the timing and magnitude of the original shock may be well known, but the timing and magnitude of pass-through into the CPI is much less certain. One approach is to use a model simulation to obtain an estimate for the feed-through effects of the shock. This approach has been used at the Reserve Bank to estimate price level effects of tariff rate and oil price changes. A drawback with using model-based estimates for this purpose is that the estimates will be model-specific; that is, a different model will give a different estimate. This opens the results to dispute and makes independent verification more difficult.

A second problem with the specific adjustment method is that it is unavoidably somewhat arbitrary in dealing with relative price disturbances. This is because all prices are relative prices and because at least some prices will be changing at any point in time. In such circumstances, specific adjustment can only be applied very selectively. Some method of screening price changes must, therefore, be set up to complement the adjustment procedure. Such screening may be systematic and unbiased, but it is still essentially arbitrary in nature. Apart from this problem, the Bank's method of screening —which is based on cumulative contributions to inflation within a 12 month period, and a threshold of significance in terms of the impact on measured inflation—has the drawback of leading to retrospective adjustments to estimated underlying inflation. As noted earlier, this is not ideal from the perspective of setting monetary policy and also often has the paradoxical effect of leading to downward revisions to estimated underlying inflation when there is a shock which raises the headline rate.

2. Adjustment by exclusion or replacement

Whereas the method of specific adjustment discussed above lends itself to dealing with readily identifiable shocks affecting diverse sub-components of the aggregate price index, adjustment by exclusion lends itself to dealing with particular sub-components of the aggregate price index whose behaviour is judged to differ frequently and significantly from the behaviour of prices in general. Exclusion also lends itself to dealing with the perverse effects of interest rate movements on the CPI. By removing such sub-components from the aggregate index, the modified index should be a more accurate indicator of underlying inflation.

In contrast with the specific adjustment approach outlined above, in which the price effects of a particular disturbance are purged from the aggregate price index, adjustment by exclusion or replacement leads to the complete deletion of a particular sub-component series of the aggregate price index and, possibly, to its replacement with another series. This approach makes most sense when much of the variation in the aggregate price index is attributable to frequent but one-off or temporary shocks to a particular sub-component of the index. Conversely, the approach is not well-suited to dealing with shocks, such as an indirect tax rate change, that have quite diffuse effects on the target price index.

Internationally, the sub-component price series most commonly excluded from underlying measures of inflation are food and/or energy prices (e.g. United States, Japan,

---

6 Underlying inflation is used a bit loosely here. Central banks in several countries publish and discuss measures of the CPI excluding various sub-components but do not explicitly define these adjusted indexes as 'underlying' inflation.

Reserve Bank Bulletin, Vol 57, No. 2 1994 113
Germany, Canada and Australia). In some cases, the food and energy components are quite broadly defined, while in others only some energy prices (e.g. fuel) or some food prices (e.g. fresh fruit and vegetables) are excluded from the underlying inflation measure. The basic rationale for excluding these particular component prices is that they tend to be particularly volatile. Australia also employs a series which excludes prices that are regarded as being primarily determined in the public sector rather than by market forces. The rationale for excluding such prices is essentially that their movements may bear little relation to underlying market forces. Canadian evidence, however, suggests that, in practice, regulated prices may well evolve quite similarly to market-determined prices, in which case it may not be very useful to exclude such prices from underlying inflation.

As well as excluding some items from the price index, it is also possible to replace items. Both the United Kingdom and New Zealand have used this method to deal with the inappropriate measurement of housing costs in the official CPI. In both the Reserve Bank's HAPI and the Bank of England's HARP, the mortgage interest component of the CPI (or RPI) is replaced by a superior measure of the cost of housing services. The Reserve Bank's official underlying inflation series, however, simply excludes mortgage interest charges rather than replacing them.

An issue which particularly arises with the method of adjustment by exclusion or replacement is whether the trend of the excluded series differs significantly from that of the overall CPI. If so, an additional adjustment may be called for. One possibility is that instead of completely eliminating an unrepresentative price series from the underlying inflation series, the drift or trend part of the series would be retained. Alternatively, if a target were specified in terms of overall CPI inflation, an informal target for an underlying series could be adjusted to reflect differences in trend arising from the exclusion of components having different trends from the overall CPI. How likely this is to be a significant issue will vary from component to component and from country to country. In the case of Canada, the Bank of Canada does not find a significant difference between the trend of the overall CPI and the trend of the food and energy sub-component. In contrast, there does appear to be a higher trend rate of inflation in regulated Canadian prices than in the overall CPI.

3. **Agnostic adjustment**

The methods of adjustment outlined above are the most common and traditional. Nonetheless, both are arbitrary methods in some important respects. With specific adjustments, judgement must be exercised in deciding when a disturbance is sufficiently significant to warrant making an adjustment. Similarly, with adjustment by exclusion,

---

8 As indicated in Reserve Bank of Australia (1992), these prices may include those set directly by government (e.g. local rates, medicare charges, postal and telephone charges) as well as prices that are heavily regulated by government (e.g. child care charges, pharmaceutical prices). The range of such prices, covering about 14 percent of the Australian CPI is thus broader than the government charges discussed in the New Zealand PTA.
judgement is required in deciding which price series to exclude. If the past relative volatility of CPI sub-component prices is used as a guide, there is an implicit assumption made that the future relative volatility of these sub-components will resemble that of the past.

Some recently proposed methods of adjustment rely much less on judgements about when or what to adjust and, therefore, may be characterised as more agnostic. Two basic alternatives—median and trimmed mean inflation—are considered below. At present no central bank uses these measures as its official underlying inflation measure, probably because they are still very new. Recently, however, the Bank of England has included both types of measure in its repertoire of underlying inflation indicators.\(^\text{13}\)

(a) Median inflation

In each of the methods of adjustment discussed so far, the basic idea has been to purge the headline measure of inflation of individual price shocks or entire price series that obscure the general or on-going tendency of inflation. The rationale behind using the median rate of inflation as an indicator of underlying inflation is the same, essentially because it places greater weight on the general trend or tendency of prices, and less weight on extreme or ‘unrepresentative’ price movements than does the mean rate of inflation used in calculation of the headline inflation rate.

An important advantage of this method of deriving a measure of underlying inflation is that the method of adjustment is completely systematic; that is, no arbitrary judgement is called for in deciding when to make an adjustment to headline inflation, and potential adjustments are not restricted to any arbitrarily selected sub-set of CPI components.

Although most readers may be familiar with the mean and the median from their school days, it may nonetheless be useful to review how and when the two will differ. To this end, consider the following simple example: suppose that in a particular quarter, 95 percent of the prices (by CPI regimen weight) increase by exactly 1 percent, while the price of one component (say, oil), accounting for 5 percent of the regimen, increases by 25 percent. The headline CPI, based on the arithmetic mean of prices, would show an average increase of 2.2 percent, more than twice the increase of 95 percent of the index. In contrast, the median increase would be just 1 percent. This is because the median is the ‘middle’ price increase in the sense that half of the CPI sub-components (by weight in the CPI regimen) will have risen by more than the median, and half by less. Since, in this example, more than half the index rises by only 1 percent, the ‘middle’ increase is also 1 percent.

The difference between the mean and the median would be of no real importance if the distribution of CPI sub-component price increases was symmetric. This is because the influence of outlier price changes on one end of the distribution of price changes would be offset by outliers at the other end of the distribution in terms of ‘pulling’ the mean away from the median inflation rate. However, if the distribution of CPI sub-component price increases is asymmetric or skewed (as in the example above), then, compared with the median, the mean inflation rate will be ‘pulled’ in the direction of the outliers (i.e. in the direction of the skewness).

---

Although statistics may tell us how the mean and median may move relative to one another and the direction of skewness, an economic interpretation is necessary to decide whether we should regard the mean as being `pulled' away from the `true' underlying inflation rate, or whether the median is being `pushed' away. On this question, recent theoretical and empirical analysis supports the case for viewing the median as a more reliable indicator of underlying inflation than the mean.\textsuperscript{14} The basic reasoning is quite simple. In the absence of relative price shocks, most firms will periodically raise their prices in line with their expectations of the general rate of inflation (or, alternatively, in line with the general rate of increase in costs). These expectations may be interpreted as representing underlying inflation.\textsuperscript{15} When a relative price (or cost) shock occurs, firms have to decide whether to change their prices immediately or wait until they would normally or routinely adjust their prices. If there are costs associated with adjusting prices, firms will tend to wait unless there is a large relative price shock. As a result, most firms will increase prices in line with general inflation expectations, while only firms affected by substantial relative price or cost disturbances will change their prices in an out-of-step way. In such circumstances, most prices will exhibit a considerable degree of `inertia' around the general rate of inflation, and this will dominate the median measure of inflation. Relative price shocks, however, will tend to shift the mean inflation rate away from the underlying rate.

Empirical evidence for the United States appears to fit quite well with the theory. In particular, the evidence suggests that significant deviations of the mean from the median inflation rate do correspond well to episodes in which relative price or aggregate supply shocks (e.g., the oil price shocks of the 1970s) were known to have occurred.\textsuperscript{16} Corroborating support for the view of the median as a better measure of underlying inflation than the mean is provided by Bryan and Cecchetti (1993) who find that median inflation is more closely related to money growth than is mean inflation.

\textbf{(b) Trimmed mean inflation}

The discussion of the median rate of inflation indicates that when the distribution of price changes is skewed, the headline rate of inflation will tend to give a misleading impression of the general tendency of inflation. The median is a particularly simple measure of central tendency in inflation that is relatively free of the distorting effects of outliers, but other possibilities also exist. Perhaps the main alternative worth considering is the \textit{trimmed mean}.\textsuperscript{17}

In contrast with the median, which places much less weight than the mean on outlier price changes, the trimmed mean ignores outlier price changes altogether. Roughly speaking, the rationale behind using this method is that the distribution of prices changes in a given period may be thought of as consisting of two components. The first consists of those price changes based on firms' expectations of the underlying, general rate of inflation. Since expectations errors, or small relative price shifts are unlikely to exhibit substantial skewness, the central tendency of these prices may be measured by the mean. The second

\textsuperscript{14} See, eg, Cahallero and Engel (1993) and Ball and Mankiw (1992) and references therein.

\textsuperscript{15} Parkin (1984), for example, shows that Eckstein's (1981) definition of "core" inflation really boils down to the expected rate of increase in unit labour costs which, in turn, may simply reflect expected inflation.

\textsuperscript{16} Ball and Mankiw (1992).

\textsuperscript{17} The trimmed mean measure is developed in Bryan and Cecchetti (1993).
component consists of a minority of prices which mainly reflect relative price movements and which tend to impart skewness to the overall distribution of prices. The trick, of course, is to distinguish between the two components. The trimmed mean approach does this by cutting off the tails of the distribution of prices. In other words, all the largest price changes (both negative and positive) in CPI sub-components are simply given a zero weight in calculating a modified mean rate of inflation.

The trimmed mean has both advantages and disadvantages in comparison with the median as measure of underlying inflation. Perhaps the main advantage is that, like the headline inflation rate, it still uses the concept of the mean rate of inflation, albeit applied to a sub-set of CPI components. The main disadvantage is that the choice of the cut-off point at which price changes receive a zero weight is largely arbitrary. 18

Empirically, Bryan and Cecchetti (1993) come to the conclusion that for the United States, at least, the median appears to be a better indicator of underlying inflation than is the trimmed mean, but that both are better indicators than either the headline CPI or the CPI excluding food and energy.

V Measures of underlying inflation for New Zealand

1. The Reserve Bank’s current underlying inflation series

The Reserve Bank’s current underlying inflation series is the official (headline) CPI adjusted essentially in line with the PTA “caveats”, with the method of adjustment varying according to the particular CPI sub-component. Two methods of adjustment are employed:

(a) Adjustment by exclusion is applied to the credit charges sub-components of the CPI.

(b) Specific adjustment has been used to remove the one-off effects of a variety of shocks to indirect taxes (eg. the introduction of the GST and tariff rate changes) and government-controlled prices (eg. health and education charges), as well shocks to important commodity prices (eg. oil and timber prices).

Figure 1 shows how this measure of underlying inflation compares with the headline measure of consumer prices since the start of 1989. Both series are shown in terms of 12-month rates of change, as it is this rate which the Reserve Bank is required to target.

As can be seen from the figure, the 12-month profile of the current measure of underlying inflation (labelled UCPII in the Figures) has been noticeably flatter over the 1989-93 period than has the headline rate. As can be seen from the differential between the two inflation measures, this reflects the fact that through the period up to mid-1991, headline inflation is judged to have been boosted by various shocks, while since then, shocks have, on balance, dampened the headline rate.

18 Bryan and Cecchetti (1993) adopted a 15 percent trimmed mean (i.e. a mean of the central 85 percent of price movements) on the basis that it had a lower monthly variance (for the U.S. CPI) than trimmed means using higher or lower fractions of CPI sub-component price movements.

Reserve Bank Bulletin, Vol 57, No. 2 1994 117
Figure 1
Headline vs underlying inflation, 89Q1-94Q1
12-month % changes
(UCPII = RB underlying inflation measure)

Figure 2 decomposes the differential between the headline and underlying measures of inflation into three components. The first of these is the contribution stemming from changes in the rate of GST (which, as noted above, is removed from the headline rate by specific adjustment). As can be seen from the figure, this significantly boosted the headline rate for about a year, beginning in 89Q3. The second is the contribution of changes in interest rates (which are systematically excluded from underlying inflation). Through virtually the whole period, it can be seen that declines in nominal interest rates imparted a downward drift to headline inflation that is absent from the underlying

Figure 2
Shocks to headline inflation, 89Q1-94Q1
contributions to 12-month % change
(UCPII = RB underlying inflation measure)
measure. Finally, relative price or supply disturbances (which are excluded from the headline rate by specific adjustment) are estimated to have boosted the headline rate through virtually the entire period, although to a lesser degree in the latter part of the period than early in the period.

The negative contribution of interest rates to headline inflation and the positive contribution of relative price disturbances through the 1989-93 period, are also revealed in Figure 3. Here the levels of the headline and underlying CPI are compared with the CPI excluding interest cost and GST effects (PXIG). The figure shows that, after an initial boost in 1989 (reflecting the GST increase), the headline CPI has drifted down relative to the CPI excluding interest costs and GST. This indicates that interest costs, over this period at least, have made a negative contribution to the headline inflation rate. By contrast, the Bank’s underlying CPI measure has drifted gently, but fairly steadily downward relative to the CPI excluding interest and GST. This indicates that underlying inflation has been pulled down or, more properly, headline inflation has been pushed up, by relative price disturbances.

This downward drift in the underlying CPI, due to relative price effects, is a potential cause for concern. Because the Bank’s formal inflation target is the headline CPI, it is important that the underlying measure of inflation not have a systematically different trend. To date it has not, reflecting the fact that relative price effects on the headline rate have been more or less offset by interest cost effects on the headline rate. The concern is that this sort of offset cannot continue indefinitely, since nominal interest rates cannot decline indefinitely.

The root of the problem is that the estimated relative price shocks over the period considered have mostly been inflation-boosting shocks. This suggests one of two possibilities: either that there is some sort of systematic bias in our method of estimating such shocks, or that there is no bias but that the shocks over the particular period in

*Reserve Bank Bulletin, Vol 57, No. 2 1994*
question just happen to have been mainly inflation-boosting ones. If measurement bias is the problem, then a redefinition of our underlying inflation measure may be warranted. If the apparent problem is simply due the particular sample of shocks, the problem should resolve itself over time. For this reason, it is useful to consider alternative means of measuring underlying inflation, as they may be able to shed light on whether our current method of estimating relative price shocks is flawed.

2. CPI excluding volatile components

An alternative to the specific adjustment method characterising the Reserve Bank’s current approach to estimating underlying inflation is to systematically exclude those components of the CPI which are believed to mask the general evolution of prices. In the Bank’s current measure of underlying inflation, mortgage and credit interest components are systematically excluded. Together these components had a weight of 7.8 percent in the CPI regimen applying over the 1989-93 period.

Adjustment by exclusion overcomes many of the drawbacks, discussed earlier, associated with the specific adjustment method. In particular, by eliminating the need for establishing a threshold criterion to screen for significance, several elements of subjectivity are also eliminated. This makes it much easier to calculate as well as explain.

Where an important element of subjectivity remains is in the choice of which CPI sub-components to exclude. Common practice overseas is to exclude food and energy items, on the basis that these are characterised by exceptionally volatile price movements. In addition, and as also discussed earlier, mortgage interest costs and the prices determined in the public sector are also sometimes excluded. When items are excluded on the basis of historical volatility, however, problems will arise if the historical pattern does not continue to hold. Similarly, exclusion of prices determined by public authorities will be invalidated if, for example, deregulation or privatisation leads to market pricing of the items in question.

The construction of a series for the CPI excluding volatile components for the purposes of this paper illustrates the subjectivity implicit in this means of estimating underlying inflation. The first area in which an arbitrary judgement is called for is in deciding at what level of price aggregation exclusion should occur. For the purposes of this analysis, an intermediate level of aggregation, involving 31 CPI sub-components was constructed.\(^{19}\) The difference between this aggregation and the Statistics New Zealand 21 sub-component aggregation is two-fold. First, in the series used for this analysis, all the interest cost series were taken out of the 21-series aggregations and grouped as a separate interest cost series. Second, the larger of the 21-series aggregations were subdivided into smaller groups so as to have more evenly-sized aggregations.

The second issue calling for judgement is on how many sub-components to exclude. For the purposes of this paper, a limit of around 15 percent of the CPI was judged to be within reason. This is about the limit typically found in such measures overseas.

\(^{19}\) Statistics New Zealand has three standard levels of aggregation. For the 1989-93 CPI regimen, the lowest standard level of aggregation involves 333 price series. The weights of these series in the regimen vary from about 0.1 percent to 6.35 percent of the regimen. An intermediate level of aggregation involves 21 price series, with weights varying from 0.4 percent to 19.3 percent of the regimen. The highest level of aggregation involves 8 price series, with weights varying from 4.9 percent to 23.5 percent of the regimen.

Reserve Bank Bulletin, Vol 57, No. 2 1994
The third issue is which particular series to exclude. Table 1 compares the volatility of the 7 most volatile sub-components of the CPI (in terms of quarterly price movements) over the 1989-93 period.

Table 1 shows that if we wish to exclude ‘volatile’ items, we have first to decide what the relevant period is over which the volatility is measured. For the purposes of this paper, the focus is on quarter-to-quarter volatility. The rationale is essentially that, although the policy target is specified in terms of 12-month inflation, it may be more useful for the interpretation of each new quarter’s data to strip out the noisiest sub-components. A good example may be, say, fresh fruit prices. Even if these may not be especially volatile on a 12-month basis, they may be highly seasonal. In this case, excluding them from the underlying inflation measure may be more or less equivalent to seasonally adjusting the CPI. By contrast, a series such as interest costs may show no seasonality and only small movements from quarter to quarter but, cumulatively, such movements may well lead to considerable volatility on a 12-month basis. Which is the ‘proper’ or most useful frequency to focus on is not clear cut.

<table>
<thead>
<tr>
<th>CPI sub-component</th>
<th>Standard deviation of quarterly % changes</th>
<th>Standard deviation of 12-month % changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI regimen weight (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit &amp; vegetables</td>
<td>2.56</td>
<td>5.94</td>
</tr>
<tr>
<td>Healthcare</td>
<td>2.16</td>
<td>5.82</td>
</tr>
<tr>
<td>Petrol</td>
<td>3.74</td>
<td>3.95</td>
</tr>
<tr>
<td>Cigarettes &amp; tobacco</td>
<td>2.63</td>
<td>3.16</td>
</tr>
<tr>
<td>Local authority rates</td>
<td>1.34</td>
<td>2.86</td>
</tr>
<tr>
<td>Meat, fish &amp; poultry</td>
<td>3.53</td>
<td>2.65</td>
</tr>
<tr>
<td>Interest costs</td>
<td>7.79</td>
<td>2.23</td>
</tr>
<tr>
<td>Total CPI</td>
<td>100</td>
<td>0.80</td>
</tr>
</tbody>
</table>

\(^1\) 1989Q4-93Q4

A more difficult problem is that there is no guarantee that the CPI sub-components with the most volatile prices over one sample period will also be the most volatile in the next period. A good case in point is that in the 1984-88 period, 2 of the 4 most volatile series were not even among the 9 most volatile series in the 1989-93 period, and none of the 3 most volatile series for each sample period was among the top 3 in the other period.

Given these inherent problems in the method, it was decided to:

- Exclude the interest cost sub-component and GST effects, even though interest costs were somewhat less volatile than some other items. This was done partly in order to facilitate comparison between this and alternative approaches.
to dealing with relative price shocks. More fundamentally, the rationale for excluding interest costs is unrelated to the volatility of the series.

- Exclude the fruit & vegetable and petrol sub-components. As shown in Table 1, these two sub-components were among the most volatile components of the CPI in the 1989-93 period (as well as in the 1984-88 period). The main reason for excluding these sub-components rather than, say, the fruit & vegetable and healthcare sub-components is that a series excluding some measure of food and energy prices is the most commonly used definition of underlying inflation internationally and, therefore, may be of some interest in its own right. The main reason that the healthcare sub-component is not excluded in addition to the other two is that, together with the exclusion of the interest cost sub-component, the exclusion of all these items would breach the self-imposed limit of not excluding more than 15 percent of the CPI. As it is, the interest cost, fruit & vegetable and petrol sub-components together account for 14.1 percent of the CPI regimen.

Figure 4 shows the resulting measure of underlying inflation (UCPI2) compared with the headline inflation rate. In contrast with Figure 1, this measure of underlying inflation shows a fairly systematically higher trend rate than the Bank’s measure of underlying inflation over the whole 1989-93 period.

Figure 4
Headline vs underlying inflation, 89Q1-94Q1
12-month % changes
(UCPI2 = CPI ex. int., GST, fruit & veg., petrol)

---

20 INFOS 1988 series S69B1, with a CPI weight of 2.56 percent.
22 A second reason is that, after actually having calculated a series that also excluded the healthcare sub-component, its behaviour was not found to differ very markedly from the series that did not exclude healthcare.
23 Together, the four CPI sub-components account for 16.25 percent of the CPI regimen.
The reason for this difference between the two underlying inflation measures is revealed in Figure 5, which compares the estimates of relative price shocks to the headline inflation rate. Whereas the Bank’s measure of underlying inflation shows a predominance of inflation-boosting relative price disturbances, the CPI excluding fruit, vegetables and petrol (in addition to interest costs and GST) shows mostly inflation-dampening shocks. This difference is also shown quite clearly in Figure 6, which compares the levels of these two measures of the underlying CPI with the CPI excluding only interest costs and GST. In this figure, the CPI excluding fruit, vegetables and petrol has a slight upward drift, relative to the CPI excluding interest and GST, in contrast to the downward drift in the Bank’s underlying CPI measure.

![Figure 5](image)

**Figure 5**

Shocks to headline inflation, 89Q1-93Q4
contributions to 12-month % changes
(UCPI2 = CPI ex. int., GST, fruit & veg., petrol)
(UCPI1 = RB measure of underlying inflation)

3. **Trimmed mean inflation**

As discussed in Section IV, the trimmed mean measure of underlying inflation systematically removes (by zero-weighting) extreme or outlier movements in CPI sub-component prices. Like the Bank’s measure of underlying inflation, but in contrast with the adjustment by exclusion method, which permanently removes the effects of predetermined CPI sub-components, the trimmed mean method temporarily removes the effects of potentially any CPI sub-component.

In contrast with the Bank’s underlying measure of inflation, the trimmed mean is highly systematic, making it readily verifiable by an independent observer. But the measure is still not completely free of arbitrary judgement. The key element of arbitrariness is in deciding how to trim the mean. The “norm” (from a very limited number of studies)
appears to be to trim the top and bottom of the distribution of price changes by about 7.5 percent (by regimen weight), for a total of 15 percent. The 15 percent figure is close to weight of the food and energy components often excluded in an alternative measure of underlying inflation. But the essential point is that the extent of trimming and the symmetry of trimming are arbitrary. We could trim, say, 20 percent. Or we could trim price changes more than, say, 2 1/2 standard deviations from the mean.

For the purposes of this article, it was decided to apply a symmetric, 15 percent trim, using the full 333 CPI sub-component disaggregation of prices. The 15 percent trim comprises a 7.8 percent systematic exclusion of the interest cost sub-components of the CPI plus the top 3.6 percent and bottom 3.6 percent (by regimen weight) of CPI sub-component price changes at the quarterly frequency. In addition, and as with the other measures of underlying inflation, GST effects were removed.

Figure 7 shows how the trimmed mean measure of inflation (UCPI3) has evolved on a 12-month basis. Broadly speaking, the trimmed mean measure of underlying inflation appears to have moved fairly similarly to the Bank’s current underlying inflation measure. Figure 8 shows more clearly the similarities and differences between the two measures. In the 1990 to mid-1991 period, the trimmed mean measure provides a lower, though still positive, estimate of relative price shocks to the headline rate, while from mid-1991 to early 1993, the two measures show almost identical estimated relative price shocks to the headline rate. In 1993, the measures again diverge, but not on the same scale as in 1990.

Figure 9 shows the level of the trimmed mean CPI and the Bank’s underlying CPI measure relative to the CPI excluding interest costs and GST (PXIG). The salient point is that the downward drift in the trimmed mean measure, relative to the CPI excluding interest and GST is very similar to that of the Bank’s current measure. This contrasts with the slight upward drift found in the measure of underlying inflation based on systematic exclusion of food and energy items.
Since the trimmed mean is able to capture relative price shocks from any source, the difference in trend drift between the trimmed mean and the CPI excluding food and energy can be attributed to significant positive relative price shocks to non-food, non-energy sub-components of the CPI. What this suggests is that the drift or bias observed in the Bank’s current measure of underlying inflation is not primarily due to bias in the Bank’s identification of relative price shocks (in favour of positive shocks) but, rather, to an asymmetry in the underlying pattern of relative price shocks over the 1989-93 period.
4. Weighted median inflation

Like the trimmed mean measure of inflation and the Bank’s current measure of underlying inflation, the weighted median measure is based on removing the influence of extreme price movements on the headline inflation rate. Of the three measures, however, the weighted median is the least arbitrary because it alone involves no arbitrarily set threshold for removing the influences of extreme price movements. Indeed, the weighted median is as free of arbitrary value judgements in its construction as the CPI itself.

Figure 10 shows the weighted median inflation rate (excluding interest costs and GST, as for each of the other measures), based on the quarterly movements of the fully disaggregated 333 CPI sub-component price series, in addition to the headline CPI rate.

Figure 11 shows the estimated impact on the headline 12-month inflation rate of relative price shocks, using the weighted median inflation rate and the Bank’s underlying inflation measure. The figure indicates that both measures yield very similar timing for shocks, but some differences in the estimated magnitude of relative price shocks. Whereas the Bank’s underlying inflation series shows a trend towards smaller shock magnitudes through the 1989-93 period, the weighted median shows much less of a change in shock sizes.

Finally, Figure 12 shows the levels of the weighted median and the Bank’s underlying inflation measure relative to the CPI excluding interest and GST effects. The downward drift in the weighted median measure supports the assessment that the downward drift in the Bank’s measure of underlying inflation is not due to any judgemental bias, since non-judgemental methods generate essentially the same result.
VI Conclusions and directions for research

The analysis of the Bank’s measure of underlying inflation, and the comparison of this measure with alternative measures, points to some problems with the current measure, mainly with respect to its transparency and timeliness. Some other methods of estimating underlying inflation are more ‘mechanical’ and transparent in certain respects.
How accurately these alternative methods measure underlying inflation, as defined by the PTA, remains the subject of on-going research. Of particular interest is the issue of what may account for the apparent tendency for the Bank’s underlying inflation measure, as well as the trimmed mean and weighted median, to all show mainly inflation-boosting effects arising from relative price movements.

References


Reserve Bank Bulletin, Vol 57, No. 2 1994


Reserve Bank Bulletin, Vol 57, No. 2 1994