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4. Measurement Issues in the New Zealand Consumers Price Index
(Revised version)

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Statistics NEW ZEALAND Te Tari Tatau

1. Introduction

As a relatively small National Statistical Office, Statistics New Zealand has adopted a pragmatic and inclusive approach to addressing measurement limitations within the Consumers Price Index (CPI). The approach is based on the regular establishment of a Revision Advisory Committee (RAC) comprised of a cross section of CPI users who advise the government statistician on the content and form of the CPI. This committee last met in 2004.

To inform the RAC process Statistics New Zealand prepared a suite of research papers covering measurement issues in the CPI. These papers outlined the issues and international best practice as well as attempting, where possible, to quantify the impacts. This work and the outcomes from the RAC process have formed the basis for this paper.

2. Background to the New Zealand CPI

The Consumers Prices Index
The New Zealand Consumers Price Index (CPI) is released on a quarterly basis and based on the acquisition approach. It is a fixed-basket Laspeyres index which is re-weighted on a three yearly cycle using data primarily sourced from the Household Economic Survey (HES).

The primary use of the CPI is as a measure of inflation faced by New Zealand resident households. However it is also widely used as a compensation index to adjust government benefits and in wage negotiations.

Policy Targets Agreement

The Reserve Bank of New Zealand Act 1989 specifies that the primary function of the Reserve Bank shall be to deliver "stability in the general level of prices." Section 9 of the Act then says that the Minister of Finance and the Governor of the Reserve Bank shall together have a separate agreement setting out specific targets for achieving and maintaining price stability. This is known as the Policy Targets Agreement (PTA).

The target set out in the PTA requires the Reserve Bank to keep inflation, as measured by the CPI, within a band of 1-3% over the medium term. This target band has changed over time: initially the band was 0-2%, this was adjusted to 0-3% in 1996, and to the current band in 2002. These changes have been as a result of changing assumptions on sustainable growth and inflation rates for the New Zealand economy rather than any concerns over biases in the CPI.

3. Meeting User Needs – the RAC process

A Revision Advisory Committee is established every six years, timed to coincide with every second re-weight of the index, to provide the Government Statistician with advice on the upcoming revision to the Consumers Price Index. The committee comprises a

group selected to bring both professional expertise and the confidence of stakeholders to the review process.

The committee last met in 2004 to provide input into the 2006 revision of the CPI. An employee of the Reserve Bank of New Zealand was seconded to Statistics NZ to manage the process. The committee itself consisted of seven members selected to represent the interests of all stakeholders including business, unions, social policy etc. Statistics New Zealand staff served as advisors to the committee but did not participate as committee members.

The terms of reference for the committee were:

1. Investigate, review and form recommendations concerning the general nature and objectives of the CPI while taking account of the actual, potential and appropriate uses of the index.
2. Investigate and form recommendations concerning the general principles that should be considered in the construction of the revised CPI with specific reference to:
    - the coverage of the CPI, including the range of goods and services represented in the index and the coverage of the household population regions
    - the appropriate classifications to be used in the CPI regimen, and
    - the methodology used to calculate the index.

4. Item Substitution Bias

A Laspeyres index is a fixed-weight basket type index, with the weights reflecting the expenditure patterns in some historical period. As changes occur in the relative prices between substitutable items, consumers substitute towards those items showing lower relative price change, these historical weights become less representative of current expenditure patterns.

Comparing a Laspeyres index to a superlative index, such as the Fisher index, is a way to quantify the effect of item substitution in the CPI. Superlative index formulae average across historical and current expenditures to derive a 'representative' set of weights for index.

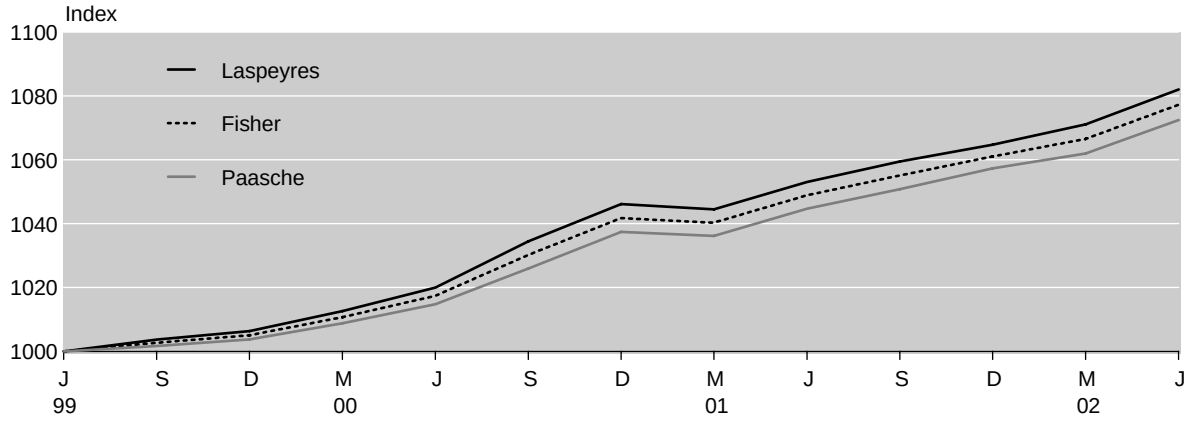
The current CPI series was re-weighted in the June quarter of 2002. The previous re-weight occurred in the June quarter of 1999. Using the June quarter 2002 weights, a Paasche index was constructed and backcast to the June quarter 1999. The Fisher index was created as the geometric mean of the Laspeyres and the Paasche series.[1]

[1] This analysis uses a common sample of about 650 representative goods and services across both the 1999 and 2002 regimen meaning that those items that disappeared from the 1999 regimen or were added into the June 2002 regimen were excluded from the analysis. The items that disappeared in the 2002 regimen amounted to about 1.3 percent of the total weight in the 1999 regimen, while those items that were added into the 2002 regimen occupied approximately 1.3 percent of the total weight in the 2002 regimen. The weights of the excluded items were not reassigned, but given the relatively small weights involved, it is unlikely to significantly affect the results.

Table 1
Comparison of alternative CPI indexes

Index type	Quarter				Inflation (%)
	Jun-99	**Jun-00**	**Jun-01**	**Jun-02**	**Jun 99-Jun 02**
Laspeyres[2]	1000.0	1020.0	1053.0	1082.0	8.2
Paasche	1000.0	1014.8	1044.7	1072.4	7.2
Fisher	1000.0	1017.4	1048.9	1077.2	7.7
Laspeyres – Fisher	**0**	**2.6**	**4.1**	**4.8**	**0.5**

Figure 1
Alternative CPI indexes



Base: June 1999 quarter (=1000)

The results show that:

- The Laspeyres index exceeds the Paasche – consistent with other studies.

- The difference in inflation rates between the Laspeyres index and the Fisher index is approximately 0.5 percent over the three-year period from the June quarter 1999 to the June quarter 2002.[3] This equates to an annual difference of around 0.16 percent, but the difference is not linear (range 0.6 to 2.6 index points). These results are in line with the results for other countries.

- The differences between the Laspeyres and Fisher indexes accumulate over time. The longer the period between re-weighting the CPI basket, the larger the 'bias'.

[2] Note that this series is the official published CPI.
[3] For the June quarter 2002 revision, there were changes in Statistics NZ's methodology for calculating expenditure weights. As a result, the differences between the Fisher and Laspeyres indexes may not be 'real'.

The best solution to account for item substitution is to use a superlative index formula, like the Fisher index. Given that this is not possible for us to do robustly in real time, the second-best solution is to re-weight the CPI as frequently as possible in order for it to maintain its relevance. However, revising the weights periodically will only minimise, not eliminate, the bias because item substitution is likely to occur continuously. Moreover, the pace of substitution will vary over time depending on consumer preferences, income levels and the magnitude of relative price changes. Statistics NZ re-weights the CPI at around three year intervals, and the ILO recommends at least once every five years.

On balance it was determined that item substitution is sufficiently well-managed by the current three-year re-weighting to ensure the fitness for use of the CPI as a measure of household inflation. However the committee recommended that with each re-weighting of the basket Statistics New Zealand calculate a superlative index on a retrospective basis to provide information on the effect of item substitution.

5. Outlet Substitution Bias

Prices for items in the CPI are collected from a range of outlets where consumers make their purchases, like item substitution, consumers may be expected to substitute their purchases towards outlets whose prices have shown lower relative price change. The choice of index formula is important in dealing with outlet substitution.

Three formulae have commonly been used to construct elementary indexes:

- The ratio of arithmetic mean prices (RAP) – also known as the Dutot formula. This is the formula currently used by Statistics NZ to construct all elementary indexes. Where outlet weights are available, they are used – otherwise prices from each outlet are equally weighted.
- The arithmetic mean of price relatives (APR) – also known as the Carli formula.
- The geometric mean of price ratios (GM) (or the ratio of geometric mean prices – the ratio of means and the means of relatives are the same) – also known as the Jevons formula

The Carli formula was traditionally used by many countries. However, it is now recognised as likely to produce an upwardly biased estimate of price change and is no longer recommended for use by the ILO. One of its flaws is the inability to handle 'price reversals'. Most countries now use either the Dutot or Jevons, or a combination of the two. Each carries a different underlying assumption about the degree of outlet substitution (reflecting different consumer preferences).

The ILO recommends that Jevons be adopted where possible, except in cases where there is little possibility for substitution, or where individual prices may become zero or near zero (since the geometric mean becomes zero). This approach has been adopted by many countries, including the US and Australia, and the committee recommended that Statistics NZ do likewise.

The process of using the Jevons formula to calculate the CPI is straightforward. The analysis here compares the difference that would have resulted had the Jevons formula been used between the December quarter 2000 and the September quarter of 2003.

The first step was to identify which of the items in the CPI regimen were unlikely to be subject to outlet substitution, or carried the possibility for zero prices. For those items, the Dutot formula was retained for the calculation of the elementary indexes. The remaining items were then calculated using the Jevons formula. Overall, approximately 65 percent of the regimen, by expenditure weight, was recalculated using Jevons.

Table 2
Difference to the CPI under the Jevons geometric mean formula

	Dec 00	**Sep 03**	**Index point change**	**Inflation %**
Dutot	1046.1	1102.6	56.5	5.4
Dutot/Jevons	1046.1	1100.4	54.3	5.2
Difference	**0**	**-2.2**	**-2.2**	**-0.2**

The results in table 3 suggest that inflation would have been approximately 0.2 percent lower, over the approximately three-year period up to September 2003, had the CPI calculation allowed for outlet substitution. This difference is relatively small when compared to the 0.5 percent difference due to item substitution (comparing Laspeyres to Fisher above).

Similar to item substitution, the conclusion is that outlet substitution is not a critical issue affecting the accuracy of the CPI. Nevertheless, implementing the Jevons formula would be relatively straightforward and bring Statistics NZ in line with international best-practice guidelines. This change will be implemented with the release of the revised CPI in 2006.

6. New Product Bias

The introduction of new products into the marketplace can present a significant issue for CPI calculation. New products, by definition, will not be in the historical period basket. If the price change pattern for the new product is the same as that for existing products in the basket, there is no real issue of bias, as the CPI price change will still be representative.

However, new products generally enter the market at high prices which fall significantly following their introduction as their market share expands. By not pricing new products, the CPI could overstate the actual price change experienced by consumers if expenditure on these products is significant.

To remove or minimise the possibility of new product bias would require an identification of the goods on entering the market, and an accurate tracking of its expanding market share (and hence, basket weight). In practice, this process is managed by Statistics NZ when the CPI basket is reviewed and re-weighted every three years. Often, beforehand, Statistics NZ will have an idea of which new products have become increasingly significant. This may be confirmed when HES expenditure data becomes available.

No other special procedures are adopted by Statistics NZ to manage new products, and none are specifically recommended in the ILO draft resolution. Paragraph 28 of the resolution does state that new goods should only be included during a basket re-weight. In that respect, Statistics NZ practices are consistent with international best practice guidelines. In general, the shorter the time between basket reviews, the less of a problem from new product bias. And again, the three-yearly re-weight is consistent with ILO guidelines of re-weighting at least once every five years.

7. Quality Change Bias

Dealing with quality change is considered as one of the more difficult and least tractable problems in constructing the CPI. Products constantly disappear from the market place and are replaced in the CPI by similar, but somewhat different, products carrying different prices. In a fixed basket, however, the same product should be priced in each period to ensure we are comparing like with like. When new products differ with respect to package sizes, volumes or other characteristics, from the original products they replace, an adjustment should be made to reflect any differences in the quality of the new product.

Inappropriate or inaccurate adjustments for changes in quality are a significant issue and can result in the CPI either overstating or understating the 'true' price change. In general, many observers view the bias as upward given the rapid rate of technological advances occurring in the marketplace.

In the 1997 review, Statistics NZ highlighted the area of quality adjustment as being the most significant for managing overall bias in the CPI. Quality change is an ongoing process that requires price statisticians' continual attention. The other sources of potential bias (item and outlet substitution, new goods, new outlets) can be effectively managed by one-off changes or periodic reviews of the CPI basket.

Developing solutions and assessing techniques for addressing the problem is difficult. Hedonic techniques currently offer the most promising tool for dealing with quality change.

At the 1997 CPI review, Statistics NZ made no use of hedonic analysis. Since that time, 'used cars', 'refrigerators', and 'fridge-freezers' have been quality adjusted using hedonic techniques and 'video cameras' are likely to be quality adjusted this way in the near future. The work program is still in its early stages, but eventually hedonic methods are

expected to be used for a number of items that experience rapid quality changes (such as personal computers).

However it would be fair to say that, given its small size, Statistics New Zealand has struggled to maintain the core group of skills needed for the development and use of hedonics. This has resulted in a fairly limited program for the introduction of hedonic methods and increased emphasis on improving more traditional quality adjustment techniques. This has emphasis has occurred via the provision of regular training in quality adjustment techniques to staff and empowering them to exercise their judgment in performing quality adjustment.

8. Measuring Housing

CPIs can be constructed under three different frameworks:

1. net acquisitions
2. payments (or outlays)
3. uses (or consumption)

In practice, for most goods and services purchased by the reference population, acquisition, payment and use all occur within a relatively short space of time. The price paid by the reference population represents a 'true' value, and there is little distinction between the three frameworks. However, the difference between the three frameworks is most pronounced for owner-occupied housing, which is explored in further detail in this analysis.

Table 3
Expenditure weight (%) of owner-occupied housing under different conceptual approaches

Re-weight quarter	Acquisitions	Payments	Uses
Dec-93	15.28	19.92	20.91
Jun-99	16.87	23.32	21.39
Jun-02	14.14	21.01	17.27

Figure 2: CPI under different treatments for owner-occupied housing

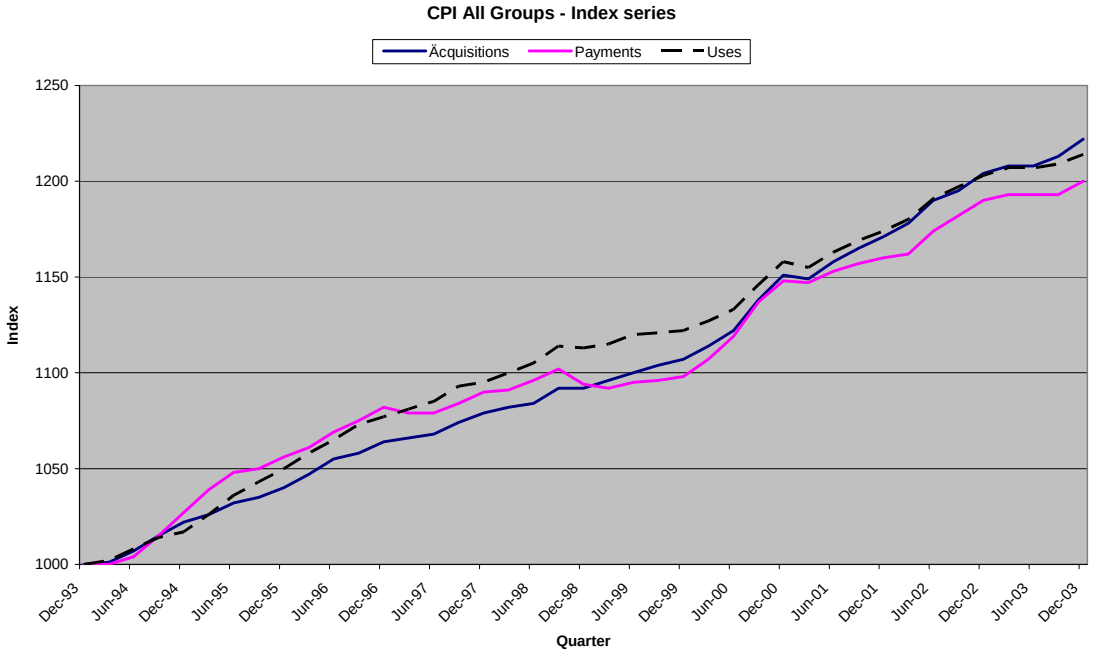


Table 4
Percentage change in index from Dec-93

	Acquisitions	Payments	Uses
Dec-93	0.0	0.0	0.0
Dec-95	4.0	5.6	5.0
Dec-97	7.9	9.0	9.5
Dec-99	10.7	9.8	12.2
Dec-01	17.1	16.0	17.4
Dec-03	22.2	20.0	21.4

The above analysis indicates that, at least over periods of time that are relevant to compensation considerations (i.e. up to five years facing rising living costs on an income that is falling behind those increases is probably undesirable from a social policy perspective), there are quite significant differences between the current acquisitions-based CPI and both the CPI+interest (payments) and the CPI-imputed rents (uses) series.

9. Outcomes of the RAC Process

Overall the committee supported the CPI remaining an acquisitions-based index measuring inflation in the goods and services purchased by New Zealand-resident private households. However the committee acknowledged that there are wide ranging uses of the CPI and that a single index cannot meet the needs of all users.

Therefore it was recommended that Statistics New Zealand provide another index, on an annual basis, as a separate series that would be more suited conceptually to measuring changes in households' cost of living. The implications of this in terms of methodology and resources required are currently being investigated by Statistics New Zealand.

The committee also supported maintaining the current three-yearly re-weighting of the index as appropriate for dealing with item substitution and new product bias with the recognition that a retrospective Fischer be compiled with each re-weight to provide information on the effect of item substitution.

For items that are deemed to be subject to outlet substitution it was recommended that Statistics New Zealand move to using the geometric means formula, this will be implemented next year. With respect to quality adjustment it was recommended that Statistics New Zealand continue with the use of hedonic regression but take account of the limits of this technique

There were a number of other recommendations of which the most significant were: the implementation of a COICOP based classification; investigating the provision of regional spatial price indexes; and the removal of seasonal adjustment from fresh fruit and vegetable prices. In total the committee made 20 recommendations, a significant number of which supported existing practices these recommendations can be seen in appendix 1.

10. Conclusion

In the current operating environment, any bias largely reflects the trade-off between the timeliness and cost of production, against the quality of the CPI. The engagement with users of the CPI must reflect this. Selecting an advisory committee representing a cross-section of users helps ensure there is general agreement on the nature and objectives of the CPI.

Providing the committee with information, where possible, on the effect of the various conceptual and methodological decisions on the CPI together with the implications (particularly in terms of resources) of changes allows the committee to make a reasoned decision helping build trust and support for the index.

It is also clear that tension over the varying, and at times conflicting, uses of the index will continue into the foreseeable future. Whilst the ‘headline’ CPI will remain targeted on measuring inflation there is increasing recognition within New Zealand that alternative measures are required. With this in mind Statistics New Zealand is investing resources into the investigation of the production of a Cost of Living index, as well as regional spatial price indexes, on an annual basis.

Appendix One

RAC Recommendations

Recommendation 1	The Revision Advisory Committee recognises the wide ranging uses of the CPI, in terms of its application as a measure of inflation and as a measure of changes in the cost of living. The committee acknowledges that a single index cannot meet the needs of all users, but also recognises the value and importance of maintaining a "single" CPI. On balance, there should remain one index branded as the "CPI" and it should remain an acquisitions-based index measuring inflation in the goods and services purchased by New Zealand-resident private households.
Recommendation 2	Statistics New Zealand should provide another index (or indexes) as separate series that would be more suited conceptually to measuring changes in households' cost of living. This additional index (or indexes) need not be published on as frequent a basis as the CPI, and an annual frequency would probably be sufficient to meet most users' requirements. The precise methodology for producing a credible and robust cost of living measure would be left to Statistics New Zealand to explore. However, in producing an index, or a range of indexes, Statistics New Zealand should take account of changes in the cost of living for different population subgroups such as superannuitants, wage and salary earners, low-income households, and recipients of government transfer payments.
Recommendation 3	Statistics New Zealand should not make changes to further enhance the CPI as a measure of inflation in the domestic economy (such as including expenditure in New Zealand by overseas tourists or removing local authority rates and similar non-market transactions) if such changes would result in the index being less suitable for measuring changes in the cost of living for New Zealand households. However, this decision could be reviewed at a time when Statistics New Zealand makes available a robust and credible cost of living index (or a range of cost of living indexes).
Recommendation 4	Statistics New Zealand should produce a "tradables/non-tradables" analysis of the CPI as a quarterly analytical series, published at the same time as the CPI All Groups index.
Recommendation 5	The Revision Advisory Committee endorses current Statistics New Zealand practices with respect to managing item substitution, new goods and new outlets, and notes that these practices are in line with ILO recommendations.
Recommendation 6	Statistics New Zealand should continue with the current three-yearly re-weighting cycle. At this stage, there is no clear evidence that the benefits of more frequent re-weighting justify the additional cost.
Recommendation 7	Statistics New Zealand should continue with current practices with respect to quality adjustment in the CPI and, in particular, the use of hedonic regression - but should take account of the limits of the application of this technique.
Recommendation 8	Within its current resources, and subject to Recommendations 1 and 3, Statistics New Zealand should continue to update its index methodologies to improve the quality of the CPI, taking into account changes in the economy, changing user requirements, and changes in international standards of good practice.
Recommendation 9	Statistics New Zealand should move to using the geometric means formula (also known as the Jevons formula) to calculate elementary aggregates for items that it deems are subject to outlet substitution.
Recommendation 10	At each re-weighting of the CPI basket, Statistics New Zealand should calculate a superlative index on a retrospective basis to provide information on the effect of item substitution on the fixed-weight CPI. Consistent with Recommendation 8, Statistics New Zealand should also assess the value of providing users with real-time estimates of the effect of item substitution on the CPI.

Recommendation 11	Statistics New Zealand should base the CPI classification system on the upper level structure of the Classification of Individual consumption According to Purpose (COICOP). Statistics New Zealand should have flexibility in the application of COICOP to the CPI, in line with the ILO recommendation that: "For the purposes of international comparisons, the classification should also be reconcilable with the most recent version of COICOP, at least at its divisional level."
Recommendation 12	As part of the risk-management process, when changes to the CPI are introduced - such as the adoption of new classifications, Statistics New Zealand should produce a backcast series. Furthermore, Statistics New Zealand should backcast over as long a time period as practical, taking into account the minimum time period required for the principal uses of the index.
Recommendation 13	Statistics New Zealand should undertake an integrated sample review of items,regions, field outlets and brands as part of the 2006 CPI revision.
Recommendation 14	Statistics New Zealand should explore the possibility of moving from national expenditure weights to using regional expenditure weights for a number of broad regions, if the use of regional weights would improve the accuracy of the national CPI. The use of regional weights would have the added benefit of supporting the derivation of "fit-for-purpose" indexes for regions such as each of Auckland, Wellington, the rest of the North Island, Canterbury, and the rest of the South Island.
Recommendation 15	Statistics New Zealand should consult with users in reviewing the number of regional centres from which prices are to be collected.
Recommendation 16	The committee recognises that there are different regional data requirements. One such requirement is for an absolute price level measurement at a point in time, via "spatial" indexes, to measure differences in the cost of living in different regions. Regional spatial indexes would also complement the range of indexes designed to measure changes in the cost of living over time (Recommendation 2). Statistics New Zealand should seek funding to develop regional spatial indexes. Consistent with recommendation 2, it will not be necessary to publish such indexes more frequently than on an annual basis.
Recommendation 17	Statistics New Zealand should adopt a consistent treatment of seasonality in the CPI and, in particular, all prices in the CPI All Groups index should be seasonally unadjusted. The committee recognises that the alternative of a fully seasonally adjusted index would require subsequent revisions, and that such revisions are unacceptable given the uses of the CPI. The committee also recognises there is likely to be some short-term disruption to annual movements during the year-long transition to a fully unadjusted CPI.
Recommendation 18	Statistics New Zealand should consider producing a seasonally adjusted CPI All Groups index as an analytical series. However, the committee attaches a relatively low priority to the production of such as index.
Recommendation 19	Statistics New Zealand should continue to produce the Food Price Index on a monthly cycle. To be consistent with the CPI All Groups index, all prices in the Food price Index should be seasonally unadjusted.
Recommendation 20	At this point in time, given the balance of users' requirements and Statistics New Zealand's resource requirements, the production of a monthly CPI is a relatively low priority.

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