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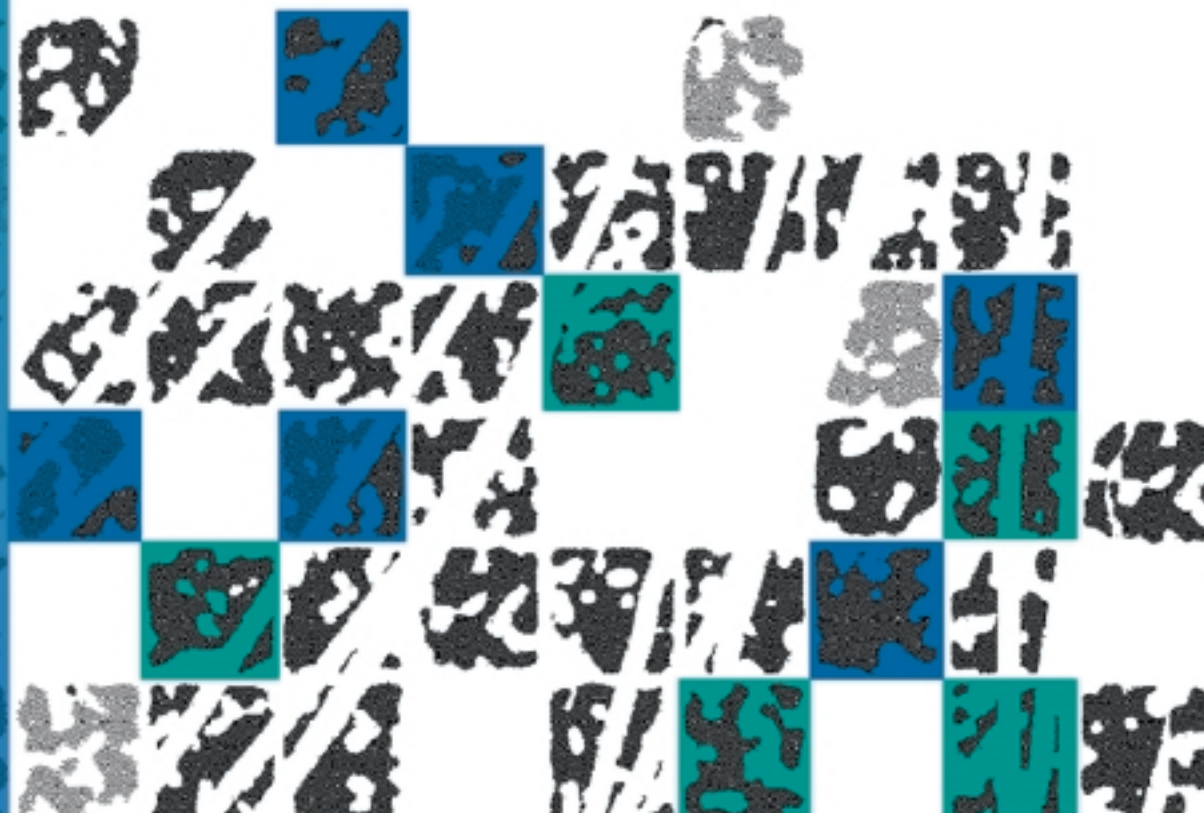
Australian Bureau of Statistics

Australian Consumer Price Index
Concepts, Sources and Methods

2003



Australian Consumer Price Index: Concepts, Sources and Methods

2003

R.W. Edwards
Acting Australian Statistician

AUSTRALIAN BUREAU OF STATISTICS

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CHAPTER 1 INTRODUCTION

AIM OF THIS PUBLICATION

1.1 This publication provides a comprehensive description of price index theory and methodology, focusing on the Australian Consumer Price Index (CPI) and the concepts, sources and methods behind its compilation. It also provides some insight into the kinds of conceptual and practical difficulties that the Australian Bureau Statistics (ABS) encounters in compiling the CPI and how it deals with these challenges.

1.2 The ABS currently publishes a brief description of the CPI in *A Guide to the Consumer Price Index, 14th Series* (cat. no. 6440.0). The Guide was prepared for those interested in a straightforward and brief account of the main features of the CPI. This publication, on the other hand, is aimed at those users who need a deeper understanding of the CPI and of the methods and techniques adopted to deal with the complex situations that arise in constructing price indexes across the whole spectrum of household consumer expenditure.

OTHER SOURCES OF CPI INFORMATION

1.3 The CPI is compiled quarterly by the ABS for quarters ending in March, June, September and December each year. The quarterly index numbers are usually published between three and four weeks after the end of the quarter in *Consumer Price Index, Australia* (cat. no. 6401.0).

1.4 The CPI is reviewed and reweighted about every five years. The last significant review of the CPI resulted in the 13th series of the index being introduced in respect of the September quarter 1998. Several major changes were made to the index at that time, most notably the decision that the CPI would change from a measure of living costs of employee households to a general measure of price inflation for the household sector as a whole. As part of this major review, the ABS published three Information Papers:

- *Issues to be Considered During the 13th Series Australian Consumer Price Index Review* (cat. no. 6451.0).
- *Outcome of the 13th Series Australian Consumer Price Index Review* (cat. no. 6453 .0).
- *Introduction of the 13th Series Australian Consumer Price Index* (cat. no. 6454.0).

1.5 These papers describe the review process, the issues considered, the review outcomes and the reweighting exercise, and outline the changes made from the previous series.

1.6 More recently, the 14th series of the CPI was introduced in respect of the September quarter 2000, after a minor review completed early in 2000. The changes introduced in the 14th series were considered necessary to address issues arising from the introduction of The New Tax System (TNTS) on 1 July 2000. Once again, as part of the review process the ABS published Information Papers detailing the changes:

- *Price Indexes and The New Tax System* (cat. no. 6425.0).
- *Introduction of the 14th Series Australian Consumer Price Index* (cat. no. 6456.0).

1.7 Some of the material in these papers is now included in the various Chapters and the Appendix of this publication.

1.8 The ABS intends to periodically update this document. Therefore, the ABS would welcome reactions from users to the issues covered in this release. Comments should be provided, preferably in writing, to Steve Whennan, Assistant Director, Prices Branch, whose contact details are given below.

1.9 Readers who would like more information on the topics discussed in this publication should write to:

Steve Whennan
Prices Branch
Australian Bureau of Statistics
PO Box 10
Belconnen, ACT 2616.

Fax: (02) 6252 7060
Email: steve.whennan@abs.gov.au

CHAPTER 2 HISTORICAL BACKGROUND

INTRODUCTION

2.1 Prior to the introduction of the CPI in 1960, there had been five series of retail price indexes compiled by the (then) Commonwealth Bureau of Census and Statistics. Those indexes were:

(i) The A Series Index, covering only food, groceries and house rents (all houses), which was first compiled in 1912, with index numbers going back to 1901, and was discontinued in 1938. Its main use was for wage adjustment purposes between 1913 and 1933.

(ii) The B Series Index, covering only food, groceries and house rents (4 and 5 roomed houses), which was first compiled in 1925 and was discontinued in 1953. It was introduced to replace the A Series Index for general statistical purposes but was never used for purposes of wage adjustment.

(iii) The C Series Index, covering food and groceries, house rents (4 and 5 roomed houses), clothing, household drapery, household utensils, fuel, lighting, urban transport fares, smoking and some miscellaneous items, which was introduced in 1921 and was discontinued in 1961. The food and rent component of the C Series Index was the same as that for the B Series Index. The C Series Index was used for the purposes of wage adjustment from 1934 to 1953.

(iv) The D Series Index, which was derived by combining the A and C Series Indexes and was compiled especially for wage adjustment purposes for a short period in 1933–34.

(v) The Interim Retail Price Index, covering food and groceries, house rent, clothing, household drapery, household utensils, fuel, lighting, urban transport fares, smoking and some services and miscellaneous items, was first compiled in 1954 and discontinued in 1960. The Interim Index was intended to serve as a transitional index, but to some extent it replaced the C Series Index for general statistical purposes for a number of years prior to 1960; it was never used for wage adjustment purposes.

C SERIES INDEX

2.2 By far the most important of these former retail price indexes was the C Series Index, which was the principal retail price index in Australia for close to forty years. It was first compiled in 1921, with index numbers being compiled retrospectively to 1914. C Series Index numbers were compiled for:

(i) the capital city in each of the six states

(ii) four of the larger towns in each of the six states

(iii) weighted average of five towns (including capital city) in each of the six states

(iv) weighted average of six state capital cities

(v) weighted average of thirty towns (including capital cities)

(vi) three additional towns — Whyalla, Port Augusta and Canberra.

2.3 The C Series Index was subject to a general review in 1936 and a slightly revised regimen was introduced following that review. The regimen then remained unchanged until the C Series Index was discontinued.

2.4 The main reason for the long interval without any review or change in composition of the C Series Index after 1936 was the recurrent changes in consumption patterns which occurred during and after World War II. It was considered impossible at the time to devise a revised weighting pattern which would be any more representative, on a continuous basis, of post-war consumption than was the existing weighting pattern of the C Series Index. The Commonwealth Statistician of the time, in successive editions of the Labour Report during the 1950s and 1960s, explained the absence of any reweighting of the C Series Index in the following words:

> "From the outbreak of war in 1939 to late in 1948, periodic policy changes in various wartime controls (including rationing) caused recurrent changes in consumption and in the pattern of expenditure. This rendered changes desirable but made it impracticable either to produce a new index, or to revise the old one, on any basis that would render the index more representative than it already was of the changing pattern of household expenditure in those years. When commodity rationing had virtually ceased in the latter part of 1948 action was taken by the Statistician to collect price data of about 100 additional items and to gather information as to current consumption and expenditure patterns. This was done to facilitate review of the component items and weighting system of the C Series Retail Price Index in the light of the new pattern of wage earner expenditure and consumption that appeared to be then emerging. But there supervened, in the next few years, conditions which caused wide price dispersion, coupled with a very rapid rise in prices and a new sequence of changes in consumption and in the pattern of wage earner expenditure. Under these conditions it was not possible to devise any new weighting pattern likely to be more continuously representative of conditions then current, than was the existing C Series Index on the 1936 revision."

2.5 In 1953 the decision was made to continue to compile the C Series Index on its pre-war basis but to also compile an interim retail price index based as nearly as possible on the post-war pattern of consumer usage and expenditure. Nevertheless, the C Series Index continued to be regarded by the majority of users as the principal official index and was the one used in most indexation and escalation arrangements throughout the 1950s.

INTERIM RETAIL PRICE INDEX

2.6 The Interim Retail Price Index was based on post-war consumption weights. Compared with the C Series Index, the Interim Index covered an expanded range of items, including additional foods (such as packaged breakfast foods, soft drinks, ice cream and confectionery) and services (such as dry-cleaning and shoe repairs). It retained the same weighting pattern throughout the period of its compilation and no attempt was made to revise its weights to take account of major changes in expenditure patterns and lifestyles that were occurring during the 1950s. During that decade, house renting was substantially replaced by home ownership, the use of motor cars partially replaced the use of public transport, and a variety of electrical appliances, and subsequently television, became widely used in households. During the same period, widely disparate movements occurred in the prices of different items of household consumer expenditure. It was considered that the combined impact of these factors made it impracticable to successfully introduce a comprehensive new retail price index during the period to 1960.

CONSUMER PRICE INDEX

2.7 In 1960, a new approach was implemented. Instead of the former emphasis on long-term fixed-weight indexes, the aim was to compile series of shorter-term indexes that would be chain linked together to form long-term series. The Consumer Price Index, commonly referred to as 'the CPI', was the first price index of this kind constructed in Australia.

2.8 The Consumer Price Index was first compiled in 1960, with index numbers being compiled retrospectively to mid 1948. Like its predecessor indexes, the CPI was designed to measure quarterly changes in retail prices of goods and services purchased by metropolitan wage earner households.

2.9 The CPI has been reviewed and reweighted thirteen times. At its inception in 1960, the CPI consisted of three original linked series, with changes in weights in 1952 and 1956. Weights were changed in 1960 and subsequently in 1963, 1968, 1973, 1974, 1976, 1982, 1987, 1992, 1998 and 2000. The method of linking the sequence of short-term price indexes to form one continuous series is described in Chapter 9.

LONG-TERM LINKED SERIES

2.10 To provide an approximate long-term measure of retail/consumer price change for the period since the first Australian retail price index was compiled, the ABS has constructed a single series of index numbers by linking together selected retail/consumer price index series from amongst those described above (see table 2.1). The index numbers are expressed on a reference base 1945 = 100.0, which was the end of a period of relative price stability during World War II. The successive series linked together to produce this long-term series of index numbers are:

- from 1901 to 1914, the A Series Retail Price Index
- from 1914 to 1946–47, the C Series Retail Price Index
- from 1946–47 to 1948–49, a combination of the C Series Index, excluding rent, and the housing group of the CPI
- from 1948–49 onwards, the CPI.

2.11 This long-term series of index numbers is updated each year and published in *Year Book Australia* (cat. no. 1301.0). A graph of the series (from table 2.1) is presented in figure 2.1.

FIGURE 2.1: GRAPH OF LONG-TERM RETAIL PRICE INDEX/CPI

Source: ABS

TABLE 2.1 RETAIL/CONSUMER PRICE INDEX NUMBERS (a)
(Base: Year 1945 = 100)

Year	*Index*	*Year*	*Index*	*Year*	*Index*	*Year*	*Index*
1901	47	1931	78	1961	252	1991	1898
1902	50	1932	74	1962	251	1992	1917
1903	49	1933	71	1963	252	1993	1952
1904	46	1934	73	1964	258	1994	1989
1905	48	1935	74	1965	268	1995	2082
1906	48	1936	75	1966	276	1996	2136
1907	48	1937	78	1967	286	1997	2141
1908	51	1938	80	1968	293	1998	2159
1909	51	1939	82	1969	302	1999	2191
1910	52	1940	85	1970	313	2000	2289
1911	53	1941	89	1971	332	2001	2389
1912	59	1942	97	1972	352	2002	2462
1913	59	1943	101	1973	385		
1914	61	1944	100	1974	443		
1915	70	1945	100	1975	510		
1916	71	1946	102	1976	579		
1917	75	1947	106	1977	650		
1918	80	1948	117	1978	702		
1919	91	1949	128	1979	766		
1920	103	1950	140	1980	844		
1921	90	1951	167	1981	926		
1922	87	1952	196	1982	1028		
1923	89	1953	205	1983	1132		
1924	88	1954	206	1984	1177		
1925	88	1955	211	1985	1257		
1926	90	1956	224	1986	1370		
1927	89	1957	229	1987	1487		
1928	89	1958	233	1988	1594		
1929	91	1959	237	1989	1714		
1930	87	1960	245	1990	1839		

(a) The index numbers relate to the weighted average of six state capital cities from 1901 to 1980 and to the weighted average of eight capital cities from 1981. Index numbers are for calendar years.

CHAPTER 3 PRICE INDEX THEORY

OVERVIEW

3.1 Price indexes of one form or another have been constructed for several centuries and are commonly used in everyday life. However, the complexities of price indexes are not always fully appreciated or understood. This Chapter provides an overview of the theory and practices that underpin the construction of price indexes.[1]

3.2 The Chapter commences by describing how a price index is a practical single number representation of information on many prices. It then discusses the relationship between indexes of prices, quantities and expenditures.

3.3 Two levels of construction of price indexes are described. At the lowest level is the construction of an index for a narrowly defined commodity from price observations. The other is the aggregation of these basic or elementary aggregate indexes across a range of commodities. Various mathematical formulas for constructing these indexes are discussed. The problem for prices statisticians is to select the most appropriate methodology. The advantages and disadvantages of the various formulas are discussed, along with criteria to guide decisions on the most appropriate formula.

3.4 The Chapter concludes with a discussion of index number bias which can arise from the use of inappropriate formula or index construction practices. Approaches to minimising bias are presented.

THE CONCEPT OF A PRICE INDEX

Comparing prices

3.5 There are many situations where there is a need to compare two (or more) sets of observations on prices. For example, a household might want to compare prices today with some earlier period, a manufacturer would be interested in comparing prices between markets to determine where to sell his output or to compare price movements between two points in time with movements in his production costs, and economists and market analysts need to be able to compare prices between countries and over time to assess and forecast a country's economic performance.

3.6 In some situations the price comparisons might only involve a single commodity. Here it is simply a matter of directly comparing the two price observations. For example a household might want to assess how the price of shampoo today compares with the price at some previous point in time.

3.7 In other circumstances the required comparison is of prices across a range of commodities. For example a comparison might be required of clothing prices. There is a wide range of clothing types and thus prices (e.g. toddlers' shoes, women's fashion shoes, boys' shorts, men's suits etc.) to be considered. While comparisons can readily be made for individual or identical clothing items, this is unlikely to enable a satisfactory result for all clothing in aggregate. A method is required for combining the prices across this diverse range of items allowing for the fact that they have many different units or quantities of measurement. This is where price indexes play an extremely useful role.

---

[1] The literature on price indexes is quite extensive. The intention of this Chapter is to present a broad overview of the theory drawing heavily on documents that are in many cases overviews themselves as well as to present some views of the ABS. This Chapter does not include any reference to the Divisia index as this index has data requirements that restrict its application in practice. For a detailed consolidation of price index theory and internationally recommended practices, see ILO manual on CPI (forthcoming).

The basic concept

3.8 Price indexes allow the comparison of two sets of prices for a common item or group of items. In order to compare the sets of prices it is necessary to designate one set the 'reference' set and the other the 'comparison' set.[2] The reference price set is used as the base (or first) period for constructing the index and is given an index value of 100.[3] For example, suppose for a single item the average of prices in set 1 was $15 and for set 2 was $30. Then designating set 1 as the reference set gives an index of 200.0 (30/15×100) for the comparison set while designating set 2 as the reference set gives an index of 50.0 (15/30×100) for the comparison set.

3.9 The most common comparison is between sets of prices at two points in time (temporal indexes). The points in time can be adjacent (this month and previous month) or many periods apart (this year and ten years earlier). Another application is to compare prices between regions or countries for the same time period (spatial indexes). This latter application is a useful one in which to introduce the concept of a price index.

3.10 Suppose the objective is to determine levels of household expenditure that are 'equivalent' between two cities say Darwin and Hobart. In order to do this an index is required which allows the price levels of the two cities to be compared. This can be done by specifying a 'basket' (in terms of quantities) of goods and services and pricing this basket in both cities. The ratio of the total price of the basket in each city gives a measure of overall price relativities.

3.11 The composition of the basket would depend on the comparison required. For example, suppose the household was considering relocating from Darwin to Hobart and desired to be no worse off in terms of the overall basket of goods and services it could purchase. The reference basket should then comprise the quantities of each item currently purchased by the household in Darwin. Alternatively, if the household was in Hobart and considered relocating to Darwin then it would specify the reference basket in terms of the quantities of goods and services being purchased in Hobart.

3.12 The composition of the basket reflects the consumption preferences of the subject, in this case the household. It will reflect the household's preferences under the prices and income prevailing in its current situation. Ideally what would be required is some indication of how the household's tastes or preferences might change between locations. Obviously the household could choose a different mix of items in Hobart than in Darwin reflecting differences in relative prices, climate and other factors. The overall objective though is the same—to measure the relativity between expenditures in the two cities for which the household is equally satisfied (or indifferent).

[2] This is the terminology used by Pollak (1971).

[3] By convention, the initial value for an index series is made equal to 100.

3.13 Similarly, price indexes can measure movements in prices between two points in time. Typically the method is to nominate one set of prices as the reference prices and to revalue the quantities (or basket) of items purchased in the base period by prices in the second (or comparison) period. The ratio of the revalued comparison period basket to the value of the reference period basket provides a measure of the price change between the two periods. This simple revaluation, however, does not take account of any changes or substitutions that may be made in quantities consumed in response to changes in relative prices between the two periods. Nor does it allow for any change in tastes between the two periods. These changes to the preference orderings of consumers are significant in the choice of index methodology.

3.14 Preference orderings are possibly easier to understand from the perspective of their production technology counterpart in the construction of an index of input prices for a manufacturer. Consider a company producing a certain quantity of an item in the reference period using quantities of various inputs. The input cost of producing the given level of output is simply the sum of the cost of the inputs (i.e. the sum of the quantity of each input used multiplied by its price). Now suppose the prices of the inputs change but the company produces the same level of output. If the company continued to use the same amount of each input, then simply revaluing the inputs by the new prices and expressing this cost relative to the base period cost provides a measure of the change in input prices. However, in manufacturing it is often possible to change the mix of inputs and still produce the same level of output. Thus when input prices change it may be possible for the company to change its mix of inputs to achieve a lower cost of production than if the mix was not changed. In this case the simple revaluation approach overstates the actual price change.

3.15 The handling of quantity changes that occur in response to changes in relative prices is fundamental to price index construction. Changes in the relative importance of items in the basket of goods and services can have a significant effect on index movements.

REFINING THE CONCEPT

3.16 Expenditure on an individual item is the product of price and quantity, that is:

$$e_t = p_t q_t \qquad (3.1)$$

where e is expenditure, p is price, q is quantity and the subscript t refers to the time periods at which the observations are made.

3.17 Now consider two observations on expenditure on a commodity and suppose the observations are at two points in time. Changes in the value of the commodity between the two periods can reflect a change in the quantity or the price or a change in both quantity and price. For example, suppose there are price and quantity observations on granny smith apples in two periods. In the first period the price of the apples is $2.00 kg, rising to $2.50 kg in the second period, while quantity changes from 10 kgs to 12 kgs over the same period. The movement in the price of apples is obtained by taking the ratio of the price in the second period to the price in the first period, that is $2.50/$2.00 = 1.25 or an increase of 25%. Similarly the increase in the quantity of apples is 12/10 = 1.20 or 20%. Between the two periods the expenditure on apples increases from $20 ($2.00×10) to $30 ($2.50×12), an increase of 50%, which is equal to the product of the ratios of the change in price and the change in quantity (1.25×1.20).

3.18 These ratios between the price in the current period and the price in the reference period are called price relatives. A price relative shows the change in price for one item only (e.g. the pricing of granny smith apples at one particular fruit market).

3.19 It is only necessary to have observations on two of the three components of equation (3.1) in order to analyse contributions to change in the expenditure. Using the apple example, suppose observations were only available on expenditure and price. The expenditure observations could be divided by the price to estimate quantity (or the movements in expenditure and price could be used).

3.20 Now consider the case of price and quantity (and expenditure) observations on many commodities. The quantity measurements can have many dimensions, such as kilograms, tonnes, or even units (e.g. number of motor cars) and the quantities and prices of items are likely to show different movements between periods. Answers are required to questions like: 'what has been the change over time in the overall quantity of commodities' and 'what has been the contribution of price changes to changes in the expenditure on the bundle of commodities over time'. Answering these questions is the task of index numbers — to summarise the information on sets of prices and quantities into single measures to assist in understanding and analysing changes.

3.21 In essence an index number is derived as an average of either prices or quantities compared with the corresponding average in some base period. The problem is how should the average be calculated.[4]

3.22 More formally, the price index problem is how to derive numbers I^P (an index of price) and I^Q (an index of quantity) such that the product of the two is the change in the total value of the items over the period. Let:

$$I_t^P = P_t / P_0 \text{ , and}$$

$$I_t^Q = Q_t / Q_0 \text{ , then}$$

$$I_t^P I_t^Q = E_t / E_0 \qquad (3.2)$$

where P_t , Q_t and E_t are respectively, price, quantity and expenditure on all commodities in period t and P_0 , Q_0 and E_0 are respectively, the price, quantity and expenditure in period 0 (the base period). Based on equation (3.1), E_t can be represented as:

$$E_t = \sum e_{it} = \sum p_{it} q_{it} \qquad (3.3)$$

that is, the sum of the product of prices and quantities of each item denoted by subscript i. The summation range ($i=1..N$) is not shown in order to make the formula more readable.

[4] For a more lengthy discussion see Allen (1975).

MAJOR INDEX FORMULAS

3.23 In presenting index number formulas a simple starting point is to compare two sets of prices (sometimes called bilateral indexes). Consider price movements between two time periods, where the first period shall be denoted as period 0 and the second period as period t (period 0 occurs before period t). In order to calculate the price index, the quantities need to be held fixed at some point in time. The initial question is what period should be used to determine the basket (or quantities). The options are to use:

(i) *The quantities of the first or earlier period.* This approach answers the question 'how much would it cost in the second period, relative to the first period, to purchase the same bundle of goods and services as purchased in the first period.' Estimating the cost of the basket in the second period's prices simply requires multiplying the quantities of items purchased in the first period by the prices that prevailed in the second period. A price index is obtained from the ratio of the revalued basket to the total price of the basket in the first period. This approach was proposed by Laspeyres in 1871 and is referred to as a Laspeyres price index. It may be represented, with a base of 100.0, as:

$$I_{Lt} = \frac{\sum p_{it} q_{i0}}{\sum p_{i0} q_{i0}} \times 100 \qquad (3.4)$$

(ii) *The quantities of the second (or more recent) period.* This approach answers the question 'how much would it have cost in the first period, relative to the second period, to purchase the same basket as was purchased in the second period.' Estimating the cost of purchasing the second period's basket in the first period simply requires multiplying the quantities of items purchased in the second period by the prices prevailing in the first period. A price index is obtained from the ratio of the total price of the basket in the second period to the total price of the basket valued at the first period's prices. This approach was proposed by Paasche in 1874 and is referred to as a Paasche price index. It may be represented, with a base of 100.0, as:

$$I_{Pt} = \frac{\sum p_{it} q_{it}}{\sum p_{i0} q_{it}} \times 100 \qquad (3.5)$$

(iii) *A combination (or average) of quantities in both periods.* This approach tries to overcome some of the inherent difficulties of using a basket fixed at either point in time.[5] In the absence of any firm indication that either period is the better to use as the base or reference, then a combination of the two is a sensible compromise. In practice this approach is most frequent in:

[5] To quote Fisher (1922, p. 45)
"… any index number implies *two* dates, and the values by which we are to weight the price ratios for those two dates will be different at the two dates. Constant weighting (the same weight for the same item in different years) is, therefore, a mere makeshift, never theoretically correct, and not even practically admissible when values change widely".

a) the Fisher Ideal price index,[6] which is the geometric mean of the Laspeyres and Paasche indexes:

$$I_{Ft} = \left(I_{Lt} I_{Pt}\right)^{\frac{1}{2}} \tag{3.6}$$

and

b) the Törnqvist price index, which is a weighted geometric mean of the price relatives where the weights are the average shares of total values in the two periods, that is:

$$I_{Tt} = \prod_i \left(\frac{p_{it}}{p_{i0}}\right)^{s_i} \tag{3.7}$$

where $s_i = \frac{1}{2}\left(e_{i0}/\sum e_{i0} + e_{i1}/\sum e_{i1}\right)$ is the average of the expenditure shares for the ith item in the two periods.

The Fisher Ideal and Törnqvist indexes are often described as 'symmetrically weighted indexes' because they treat the weights from the two periods equally.[7]

3.24 The Laspeyres and Paasche formulas are expressed above in terms of quantities and prices. In practice quantities might not be observable or meaningful (for example, how would the quantities of legal services, public transport and education be measured?). Thus in practice the Laspeyres formula is typically estimated using expenditure shares to weight price relatives — this is numerically equivalent to the formula (3.4) above.

3.25 To derive the price relatives form of the Laspeyres index, multiply the numerator of equation (3.4) by $\frac{p_{i0}}{p_{i0}}$ and rearrange to obtain:

$$I_{Lt} = \sum \frac{p_{it}}{p_{i0}} \left(\frac{p_{i0} q_{i0}}{\sum p_{i0} q_{i0}}\right) \times 100 \tag{3.8}$$

where the term in parentheses represents the expenditure share of item *i* in the reference (or, more commonly labelled, base) period. Let:

$$w_{i0} = \frac{p_{i0} q_{i0}}{\sum p_{i0} q_{i0}} = \frac{e_{i0}}{\sum e_{i0}} \tag{3.9}$$

then the Laspeyres formula may be expressed as:

$$I_{Lt} = \sum w_{i0} \left(\frac{p_{it}}{p_{i0}}\right) \times 100 \tag{3.10}$$

where p_{it}/p_{i0} is the price relative for the ith item.

[6] The use of the geometric mean of the Laspeyres and Paasche indexes was first proposed by Pigou in 1920 and given the title 'ideal' by Fisher (1922).

[7] See Diewert (1993) for a discussion of symmetrical averages.

3.26 In a similar manner, the Paasche index may be constructed using expenditure weights. In equation (3.5), multiply the denominator by $\frac{p_{it}}{p_{it}}$ and rearrange terms to obtain:

$$I_{Pt} = \frac{\sum p_{it} q_{it}}{\sum p_{it} q_{it} \frac{p_{i0}}{p_{it}}} = \frac{1}{\sum \frac{p_{i0}}{pit} \left(\frac{\sum p_{it} q_{it}}{p_{it} q_{it}} \right)} \times 100 \qquad (3.11)$$

which may be expressed as:

$$I_{Pt} = \frac{1}{\sum w_{it} \frac{p_{i0}}{p_{it}}} \times 100 \qquad (3.12)$$

which is the inverse of a 'backward' Laspeyres index (i.e. a Laspeyres index going from period *t* to period 0 using period *t* expenditure weights).[8]

3.27 The important point to note here is that if price relatives are used then value (or expenditure) weights must also be used. On the other hand, if prices are used directly rather than in their relative form, then the weights must be quantities.[9]

3.28 An example of creating index numbers using the above formulas is presented in table 3.1. For purposes of the exercise, a limited range of the types of commodities households might purchase has been used. The quantities that these items would typically be measured in may vary. There are likely to be differences in price behaviour of the commodities over time. Further, the quantities of these items households purchase may vary over time in response to changes in prices (of both the item and other items) and household incomes.

3.29 Differences that might arise in price changes (and, by implication expenditure patterns) are illustrated by the following:

- prices of high labour content items, such as clothing, will tend to show relatively steady trends over time
- high technology goods, such as computers, tend to decline over time, either absolutely or relative to other items, reflecting productivity and technological advances

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[8] For further discussion of forward and backward Laspeyres and Paasche price and quantity indexes, refer to Chapter 2 of Allen (1975).

[9] For example, if expenditure weights (as in equation (3.9)) are applied to prices rather than to price relatives, then:

$$I_t = \frac{\sum p_{it} w_{i0}}{\sum p_{i0} w_{i0}} = \frac{\sum p_{it} \left(p_{i0} q_{i0} / \sum p_{i0} q_{i0} \right)}{\sum p_{i0} \left(p_{i0} q_{i0} / \sum p_{i0} q_{i0} \right)} = \frac{\sum p_{it} p_{i0} q_{i0}}{\sum p_{i0} p_{i0} q_{i0}}$$

which is not the Laspeyres formula in equation (3.4). Note that the summation is over *n* price observations so that the $p_{i0} q_{i0}$ in the numerator and denominator in the last expression do not cancel out.

- prices of some items, such as fresh fruit, are affected by climatic and seasonal influences
- prices of some items might at times be influenced by changes in taxation rates (e.g. beer).

3.30 Price changes influence, to varying degrees, the quantities of items households purchase. For some items such as basic foods, the quantities purchased may show little change in response to price changes. For other items the quantities households purchase may change by a similar or greater proportionate amount than the price change.[10]

3.31 The scenarios presented in table 3.1 are merely reflective of some of these possibilities.

3.32 In table 3.2 the different index formulas produce different index numbers and thus different estimates of the price movements. Typically the Laspeyres formula will produce a higher index number than the Paasche formula, with the Fisher ideal and the Törnqvist of similar magnitude falling between the index numbers produced by the other two formulas. In other words the Laspeyres index will generally produce a higher (lower) measure of price increase (decrease) than the other formulas and the Paasche index a lower (higher) measure of price increase (decrease).[11]

Generating index series over more than two time periods

3.33 Most users of price indexes require a continuous series of index numbers at specific time intervals. There are two options for applying the above formulas when compiling a price index series:

(i) select one period as the base and separately calculate the movement between that period and the required period, which is called a 'fixed base' or 'direct' index

(ii) calculate the period to period movements and 'chain' these (i.e. calculate the movement from the first period to the second, the second to the third with the movement from the first period to the third obtained as the product of these two movements).

3.34 The calculation of direct and chained indexes over three periods (0, 1, and 2) using observations on three items, is shown in table 3.2. The procedures can be extended to cover many periods.

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[10] Economists measure the change in the quantity of an item in response to a change in price (or income) by elasticities, which are measured as the ratio of the percentage change in the quantity to the percentage change in price (or income). An item is price inelastic if the percentage change in the quantity is less than the percentage change in price. It has unit elasticity if the percentage changes are the same and is price elastic if the percentage change in the quantity is greater then the percentage change in price. If an item is price inelastic, the change in expenditure will be in the same direction as the change in price (i.e. if price increases, then expenditure also increases). If the item has unit elasticity then expenditure is unchanged. If the item is price elastic the change in expenditure will be in the opposite direction to the price change (i.e. if price increases, then expenditure decreases).

[11] The relationship between the Laspeyres and Paasche indexes holds while ever there is a 'normal' relationship (negative correlation) between prices and quantities, that is, quantity declines (increases) if price increases (declines) between the two periods.

TABLE 3.1: COMPILING PRICE INDEXES OVER TWO PERIODS

	Period 0				
Item	*Price ($)*	*Quantity*	*Expenditure*		*Price*
	$		*$*	*Shares*	*relatives*
	p_{i0}	q_{i0}	e_{i0}	w_{i0}	p_{i0}/p_{i0}
Bread (loaves)	2.50	2000	5000	0.4310	1.0000
Fresh fruit (kgs)	3.00	500	1500	0.1293	1.0000
Beer (litres)	4.50	200	900	0.0776	1.0000
Computers (units)	1500.00	2	3000	0.2586	1.0000
Clothing (units)	30.00	40	1200	0.1035	1.0000
Total			11600	1.0000	

	Period t				
Item	*Price*	*Quantity*	*Expenditure*		*Price*
	$		*$*	*Shares*	*relatives*
	p_{it}	q_{it}	e_{it}	w_{it}	p_{it}/p_{i0}
Bread (loaves)	2.75	2000	5500	0.4532	1.1000
Fresh fruit (kgs)	4.00	450	1800	0.1483	1.3333
Beer (litres)	6.50	130	845	0.0696	1.4444
Computers (units)	1000.00	3	3000	0.2472	0.6667
Clothing (units)	33.00	30	990	0.0817	1.1000
Total			12135	1.0000	

Index formula	*Index numbers*	
	Period 0	*Period t*
Laspeyres	100.0	104.5
Paasche	100.0	98.4
Fisher	100.0	101.4
Törnqvist	100.0	101.6

Note: In order to have expenditure weights summing exactly to unity, the weight for clothing has been derived as a residual.

The following illustrate the Index number calculations:

Laspeyres $(0.4310\text{x}1.1000)+(0.1293\text{x}1.3333)+(0.0776\text{x}1.4444)+(0.2586\text{x}0.6667)+(0.1035\text{x}1.1000)$

Paasche $\dfrac{1}{(0.4532/1.1000)+(0.1483/1.3333)+(0.0696/1.4444)+(0.2472/0.6667)+(0.0817/1.1000)}$

Fisher $(104.500\text{x}98.400)^{1/2}$

Törnqvist best calculated by first taking the logs of the index formula

$$\begin{aligned} & (1/2)\text{x}(0.4310+0.4532)\text{xln}(1.1000) \\ + \ & (1/2)\text{x}(0.1293+0.1483)\text{xln}(1.3333) \\ + \ & (1/2)\text{x}(0.0776+0.0696)\text{xln}(1.4444) \\ + \ & (1/2)\text{x}(0.2586+0.2472)\text{xln}(0.6667) \\ + \ & (1/2)\text{x}(0.1035+0.0817)\text{xln}(1.1000) \\ = \ & 0.015422 \end{aligned}$$

and then taking the exponent multiplied by 100

TABLE 3.2: CONSTRUCTING PRICE INDEX SERIES

Item	Period 0	Period 1	Period 2
		Price ($)	
1	10	12	15
2	12	13	14
3	15	17	18
		Quantity	
1	20	17	12
2	15	15	16
3	10	12	8
Index formula			
Laspeyres			
period 0 to 1	100.0	114.2	
period 1 to 2		100.0	112.9
chain	100.0	114.2	128.9
direct	100.0	114.2	130.2
Paasche			
period 0 to 1	100.0	113.8	
period 1 to 2		100.0	112.3
chain	100.0	113.8	127.8
direct	100.0	113.8	126.9
Fisher			
period 0 to 1	100.0	114.0	
period 1 to 2		100.0	112.6
chain	100.0	114.0	128.3
direct	100.0	114.0	128.5

3.35 An index formula is said to be 'transitive' if the index number derived directly is identical to the number derived by chaining. In general no weighted index formula will be transitive because period-to-period calculation of the index involves changing the weights for each calculation. The index formulas in table 3.2 will only result in transitivity if there is no change in the quantity of each item in each period or all prices show the same movement.[12] In both these cases all the formulas will produce the same result.

3.36 The direct Laspeyres formula has the advantage that the index can be extended to include another period's price observations when available, as the weights are held fixed at some earlier base period. On the other hand, the direct Paasche formula requires both current period price observations and current period weights before the index can be extended.

[12] This is illustrated mathematically for the Laspeyres index. Chaining the indexes for the period 0 to period 1, and period 1 to period 2 movements produces:

$$I_L^C = \frac{\sum p_{i1}q_{i0}}{\sum p_{i0}q_{i0}} \frac{\sum p_{i2}q_{i1}}{\sum p_{i1}q_{i1}}$$

which is not the same as the directly estimated index:

$$I_L^D = \frac{\sum p_{i2}q_{i0}}{\sum p_{i0}q_{i0}}$$

unless the quantities (q_{i0} and q_{i1}) are constant for each item or the individual prices show the same proportional change between periods (the trivial case of this being where there is no change in the individual prices between periods).

Unweighted, or equal-weight indexes

3.37 In some situations it is not possible or meaningful to derive weights in either quantity or expenditure terms for each price observation. This is typically so for a narrowly defined commodity grouping in which there might be many sellers (or producers). Information might not be available on the overall volume of sales of the item or for the individual sellers or producers from whom the sample of price observations is taken. In these cases it seems appropriate not to weight, or more correctly to assign an equal weight, to each price observation. It is a common practice in the CPI in many countries that the price indexes at the lowest level (where prices enter the index) are calculated using an equal-weights formula, such as an arithmetic mean or a geometric mean.

3.38 Suppose there are price observations for N items in period 0 and *t*. Then three approaches[13,14] for constructing an equal weights index are:

(i) calculate the arithmetic mean of prices in both periods and obtain the relative of the second period's average with respect to the first period's average (i.e. divide the second period's average by the first period's average). This is the relative of the arithmetic mean of prices (RAP) approach, also referred to as the Dutot formula:

$$I_D = \frac{\frac{1}{N}\sum p_{it}}{\frac{1}{N}\sum p_{i0}} \qquad (3.13)$$

(ii) for each item, calculate its price relative (i.e. divide the price in the second period by the price in the base period) and then take the arithmetic average of these relatives. This is the arithmetic mean of price relatives (APR) approach, also referred to as the Carli formula:

$$I_C = \frac{1}{N}\sum \frac{p_{it}}{p_{i0}} \qquad (3.14)$$

[13] Use of the RAP approach was first suggested by Dutot in 1738, the APR approach by Carli in 1764 and the geometric mean by Jevons in 1865 (see Diewert (1987)). Fisher (1922) described the RAP approach as the 'simple aggregative'. These are not the only possible formulas — another formula often mentioned in the literature is the harmonic mean. The harmonic mean of price relatives is given by the inverse of the arithmetic averages of the inverses of the relatives of the individual item prices, that is:

$$1 \Big/ \left(\frac{1}{N} \sum \frac{p_0}{p_1} \right)$$

The harmonic mean is equal to or lower than the geometric mean. Fisher (1922) also discusses use of the median and mode.

[14] The implicit weights applied by the three formulas are equal base period quantities (RAP), equal base period expenditures (quantities inversely proportional to base period prices) (APR) and equal expenditure shares in both periods (GM).

(iii) for each item, calculate its price relative and then take the geometric mean[15] of the relatives. This is the geometric mean (GM) approach, also referred to as the Jevons formula:

$$I_G = \prod \left(\frac{p_{it}}{p_{i0}} \right)^{\frac{1}{N}} \qquad (3.15)$$

3.39 Although these formulas apply equal weights, the basis of the weights differs. The geometric mean applies weights such that the expenditure shares of each observation are the same in each period. In other words, it is assumed that as an item becomes more (less) expensive relative to other items in the sample the quantity declines (increases) with the percentage change in the quantity offsetting the percentage change in the price. The RAP formula assumes equal quantities in both periods. That is, the RAP assumes there is no change in the quantity of an item purchased regardless of either its price movement or that of other items in the sample. The APR assumes equal expenditures in the first period with quantities being inversely proportional to first period prices.[16]

3.40 The following are calculations of the equal weight indexes using the data in table 3.2. Setting period 0 as the base with a value of 100.0, the following index numbers are obtained in period *t*:

$$\text{RAP formula: } 113.5 = \frac{\frac{1}{3}(12+13+17)}{\frac{1}{3}(10+12+15)} \times 100$$

$$\text{APR formula: } 113.9 = \frac{1}{3}\left(\frac{12}{10} + \frac{13}{12} + \frac{17}{15} \right) \times 100$$

$$\text{GM formula: } 113.8 = \sqrt[3]{\frac{12}{10} \times \frac{13}{12} \times \frac{17}{15}} \times 100$$

[15] The geometric mean of N numbers is the Nth root of the product of the numbers. For example, the geometric mean of 4 and 9 is 6 ($=\sqrt{4 \times 9}$), while the arithmetic mean is 6.5 ($=(4+9)/2$. Although the geometric mean has been presented in terms of price relatives, the same result is obtained by taking the ratio of the geometric means of prices in each period, that is:

$$\frac{(\prod p_{it})^{1/N}}{(\prod p_{i0})^{1/N}}$$

[16] The assumption underlying the equal weight APR can be illustrated with a simple example. Suppose there is a price sample of two items, selling for $5 and $4 in period 0. Suppose the prices in period *t* are double those in period 0. Assume expenditure on each item is $20 in period 0, giving quantities of 4 and 5 respectively. Then the average quantity weighted price in period 0 is $4.4444 ((4x5+5x4)/(4+5)) and $8.8889 in period *t* ((4x10+5x8)/(4+5)), giving an index of 200.0. This is the same result as taking the unweighted arithmetic average of the two price relatives ((1/2*(10/5+8/4)*100).

3.41 Theory suggests that the APR formula will produce the largest estimate of price change, the GM the least and the RAP a little larger but close to the GM.[17] Real life examples generally support this proposition,[18] although with a small sample as in the above example, substantially different rankings for the RAP formula are possible depending on the prices.

3.42 The behaviour of these formulas under chaining and direct estimation is shown in table 3.3 using the price data from table 3.2. It is noted that the RAP and GM formulas are transitive, but not the APR.

TABLE 3.3: LINKING PROPERTIES OF EQUAL WEIGHT INDEX FORMULAS

Formula	*Period 0*	*Period 1*	*Period 2*
Relative of average prices (RAP)			
period 0 to 1	100.0	113.5	
period 1 to 2		100.0	111.9
chain	100.0	113.5	127.0
direct	100.0	113.5	127.0
Average of price relatives (APR)			
period 0 to 1	100.0	113.9	
period 1 to 2		100.0	112.9
chain	100.0	113.9	128.6
direct	100.0	113.9	128.9
Geometric mean (GM)			
period 0 to 1	100.0	113.8	
period 1 to 2		100.0	112.5
chain	100.0	113.8	128.0
direct	100.0	113.8	128.1
Note: uses the same price data as in table 3.2			

Unit values as prices

3.43 A common problem confronted by index compilers is how to measure the price of items in the index whose price may change several times during an index compilation period. For example, in Australia petrol prices change almost daily at many outlets while the CPI index is quarterly. Taking more frequent price readings and calculating an average is one approach to deriving an average quarterly price. A more desirable approach, data permitting, would be to calculate unit values and use these as price measures.[19]

[17] For a mathematical proof of this see Diewert (1995). The unweighted indexes will all produce the same result if all prices move in the same proportion (have the same relative). In addition, the RAP and APR will produce the same index number if all base period prices are equal. In general, the RAP formula is expected to produce index numbers above but reasonably close to the GM. Diewert also refers to other studies that compare real world results for elementary aggregate formulas.

[18] For example, Woolford (1994) calculated these indexes for 23 fresh fruit and vegetable elementary aggregates of the Australian CPI over the period June 1993 to June 1994. He found that the GM produced the lowest increase in 16 of the 23 elementary aggregates and the APR produced the highest increase for 19 of the elementary aggregates. The RAP formula produced the middle estimate for 13 of the elementary aggregates. Combining the elementary aggregates to produce the fresh fruit and vegetables index, the index compiled using the APR estimates was 4.7% higher than the index based on GM estimates and the RAP was 1.7% higher than the index based on GM.

[19] See for example Diewert(1995) for further discussion of unit values.

3.44 The unit value for an item for a specified period is the value of expenditure divided by the quantity transacted in the period. The item must be either homogeneous or able to be expressed in terms of some common physical unit. For example, suppose outlet X sells chocolate bars in weights of 50 g, 100 g and 250 g. Further, suppose the outlet keeps records of the value of sales of these chocolate bars in aggregate and the number of each size of chocolate bar sold. It is then possible to calculate the total quantity of chocolate sold in grams. Dividing the value of expenditure on chocolate by the total quantity in grams produces a unit value that could be used as the price measure for chocolate.

3.45 The advent of scanner data is making the construction of unit values more feasible. To be successfully applied the information is required across all outlets. In effect it would remove any need for the unweighted index formulas discussed above (at least for those items where unit values are available).

DECOMPOSING EXPENDITURE AGGREGATES

3.46 Having introduced the major price index formulas, it is appropriate to re-examine the decomposition of an expenditure aggregate into price and quantity components introduced in equation (3.1). It is important to know the form of the quantity index when a particular form of the price index is used (and vice versa) to ensure the accurate decomposition of the value change.

3.47 The change in an expenditure aggregate between period 0 and t may be expressed as

$$\frac{E_t}{E_0} = \frac{\sum p_{it} q_{it}}{\sum p_{i0} q_{i0}} \tag{3.16}$$

3.48 Multiplying the right-hand side of equation (3.16) by $\frac{\sum p_{it} q_{i0}}{\sum p_{it} q_{i0}}$ allows the equation to be expressed as

$$\frac{E_t}{E_0} = \frac{\sum p_{it} q_{i0}}{\sum p_{i0} q_{i0}} \times \frac{\sum p_{it} q_{it}}{\sum p_{it} q_{i0}} \tag{3.17}$$

where the first term on the right-hand side of the equals sign is a Laspeyres price index and the second is a Paasche volume index.[20] This is referred to as the Laspeyres decomposition. In other words, if an index of value change is deflated by a base period weighted price index, then the index of quantity change is a current period weighted quantity index.

3.49 An alternative decomposition of the change in the expenditure aggregate is obtained by multiplying the right-hand side of (3.16) by $\frac{\sum p_{i0} q_{it}}{\sum p_{i0} q_{it}}$ which produces:

$$\frac{E_t}{E_0} = \frac{\sum p_{it} q_{it}}{\sum p_{i0} q_{it}} \times \frac{\sum p_{i0} q_{it}}{\sum p_{i0} q_{i0}} \tag{3.18}$$

[20] In a volume index, prices are held constant between the two periods while the actual quantities from each period are used in the calculation. The change in the index is then measuring the weighted change in the volume of purchases.

where the first term on the right-hand side of the equals sign is a Paasche price index and the second is a Laspeyres volume index. This is referred to as the Paasche decomposition. In other words, if an index of value change is deflated by a current period weighted price index, then the index of quantity change is a base period weighted quantity index.

3.50 A similar decomposition can also be undertaken for the Fisher Ideal index. By taking the geometric average of the alternative Laspeyres and Paasche decompositions of value change (right-hand sides of equations (3.17) and (3.18)) it can be shown that value change is the product of Fisher Ideal price and quantity indexes.

SOME PRACTICAL ISSUES IN PRICE INDEX CONSTRUCTION

To chain or not to chain

3.51 The use of fixed weights (as in a Laspeyres type formula) over an extended period of time is obviously not a sound index construction practice. For example, weights in a consumer price index have to be changed to reflect changes in consumption patterns. Consumption patterns change in response to longer-term movements in relative prices, changes in preference orderings and the introduction of new goods (and the displacement of other goods).

3.52 There are two options in these situations if a fixed-weight index is used. One is to hold the weights constant over as long a period as seems reasonable, starting a new index each time the weights are changed. This means that a longer-term series is not available. The second is to update the weights more frequently and to chain, as discussed above, to produce a long-term series. The latter is the most common practice.

3.53 The behaviour of the various formulas under chaining were discussed briefly above. The behaviours are further explored below in table 3.4 by adding two more periods. In period 3, prices and quantities are returned to their base period values and in period 4 the base period prices and quantities are 'shuffled' between items. The period 3 situation is sometimes described as time reversal and the period 4 situation as 'price bouncing'.[21]

3.54 Under the three formulas, the index number under direct estimation returns to 100.0 when prices and quantities of each item return to their base period levels. However, the chained index numbers do not (although the chained Fisher ideal index might generally be expected to perform better than the chained Laspeyres or Paasche).

3.55 This situation poses a quandary for prices statisticians when using a fixed-weight index. There are obvious attractions in frequent chaining. However, chaining in a fixed-weight index can sometimes lead to biased estimates. This can occur if there is seasonality or cycles in the price and chaining coincides with the top and bottom of each cycle. For this reason it is generally accepted that chaining should not be done at intervals less than annual. In effect, the conceptual underpinning of chaining is that the traditionally expected inverse relationship between prices and quantities actually applies in practice (i.e. growth in quantities is higher for those items whose prices increase less in relative terms). The *System of National Accounts, 1993* describes the practical situations in which chaining works best.[22]

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[21] Szulc (1983) applied the term 'price bouncing' to situation 3.

[22] Paragraph 16.48: ".....a chain index should be used when the relative prices in the first and last periods are very different from each other and chaining involves linking through intervening periods in which the relative prices and quantities are intermediate between those in the first and last periods. Relative prices and

TABLE 3.4: A CLOSER LOOK AT CHAINING

Item	Period 0	Period 1	Period 2	Period 3	Period 4
		Price ($)			
1	10	12	15	10	15
2	12	13	14	12	10
3	15	17	18	15	12
		Quantity			
1	20	17	12	20	10
2	15	15	16	15	20
3	10	12	8	10	15
Index formula					
Laspeyres					
period 0 to 1	100.0	114.2			
period 1 to 2		100.0	112.9		
period 2 to 3			100.0	78.8	
period 3 to 4				100.0	107.5
chain	100.0	114.2	128.9	101.6	109.2
direct	100.0	114.2	130.2	100.0	107.5
Paasche					
period 0 to 1	100.0	113.8			
period 1 to 2		100.0	112.3		
period 2 to 3			100.0	76.8	
period 3 to 4				100.0	93.8
chain	100.0	113.8	127.8	98.2	92.1
direct	100.0	113.8	126.9	100.0	93.8
Fisher					
period 0 to 1	100.0	114.0			
period 1 to 2		100.0	112.6		
period 2 to 3			100.0	77.8	
period 3 to 4				100.0	100.4
chain	100.0	114.0	128.4	99.9	100.3
direct	100.0	114.0	128.5	100.0	100.4

Handling changes in price samples

3.56 All the index formulas discussed above require observations on the same items in each period. In some situations it may be necessary to change the items or outlets included in the price sample or, if weights are used, to reweight the price observations. Examples of changes in a price sample include: a respondent goes out of business; or the sample needs to be updated to reflect changes in the market shares of respondents; to introduce a new respondent; or to include a new item.

quantities are described as intermediate when they may be approximated by some average of those in the first and last periods. This will happen when the opening prices and quantities are transformed into those of the final period by the gradual accumulation of successive changes which tend to be in the same direction. In this case, the individual links in the chain are strong as they involve comparisons between situations that are very similar to each other."

3.57 It is important that changes in price samples are introduced without distorting the level of the index for the price sample. This is usually done by a process commonly called 'splicing'. Splicing is similar to chaining except that it is carried out at the price sample level. An example of handling a sample change is shown in table 3.5, for equal weighted indexes assuming a new respondent is introduced in period t. A price is also observed for the new respondent in period t-1. The inclusion of the new respondent causes the geometric mean to fall from $5.94 to $5.83. We do not want this price change to be reflected in the index but we do want to capture the effect of respondent 4's price movement between period t-1 and t.

3.5 A CHANGE IN SAMPLE — INTRODUCING A NEW RESPONDENT

Item	Price			Price relative		
	Period			Period		
	Base	Previous	Current	Base	Previous	Current
	Period t-1					
1	4.00	5.50	6.00	1.000	1.375	1.500
2	4.50	4.50	5.00	1.000	1.000	1.111
3	5.00	5.50	7.00	1.000	1.100	1.400
Geometric mean	4.48	5.14	5.94	1.000	1.148	1.326
	Period t					
1	4.00	6.00	6.50	1.000	1.500	1.625
2	4.50	5.00	5.50	1.000	1.111	1.222
3	5.00	7.00	7.00	1.000	1.400	1.400
4		5.50	6.00	1.000	1.326	1.447
GM (all items)		5.83	6.22	1.000	1.326	1.416
GM (matched sample)		5.94	6.30			

3.58 In the case of the APR and GM formulas, this is done by:

- setting the previous period price relative for period t for the new respondent (4) equal to the average of the price relatives of the three respondents included in period t-1
- applying the movement in respondent 4's price between period t-1 and t to derive a price relative for period t.

3.59 For these two formulas, the average of the price relatives is effectively the index number, so the GM index for period t-1 is 132.6 and for period t is 141.6.

3.60 In the case of the RAP formula, the method is similar but prices are used instead of price relatives. The RAP formula uses the arithmetic mean of prices (not the arithmetic mean of the price relatives). The index for RAP can be calculated from the period to period price movements:

- between the base period and period t-1, the movement in the average price was 1.333 (6.00/4.50) without the new respondent
- between period t-1 and t, the movement in the average price was 1.063 (6.25/5.88) including the new respondent in both periods
- thus the index for period t is 141.7 (1.333x1.063x100).

Temporarily missing price observations

3.61 In any period an event may occur that makes it impossible to obtain a price measure for an item. For example, an item could be temporarily out of stock or the quality is not up to standard (as may occur with fresh fruit and vegetables because of climatic conditions).

3.62 There are various options available to handle temporarily missing observations. These include:

(i) repeat the previous period's price of the item

(ii) impute a movement for the item based on the price movement for all other items in the sample

(iii) use the price movement from another price sample.

3.63 Approach (ii) is equivalent to excluding the item, for which a price is unavailable in one period, from both periods involved in the index calculation. It strictly maintains the 'matched sample' concept.

3.64 An example of imputing using the first two approaches for the equal weighted formula is provided in table 3.6. The example assumes that there is no price observation for item 2 in period 2.

TABLE 3.6: IMPUTATION OF MISSING PRICE OBSERVATIONS

	Period			
Respondent	0	1	2	3
		Price ($)		
A	10.00	11.00	12.00	13.00
B	12.00	13.00	-	12.00
C	15.00	15.50	14.50	17.00
D	14.00	13.50	15.00	18.00
		Price relatives		
A	1.000	1.100	1.200	1.300
B	1.000	1.083	-	1.000
C	1.000	1.033	0.967	1.133
D	1.000	0.964	1.071	1.286
a) Impute using previous period's price				
Price for respondent B	12.00	13.00	13.00	12.00
Imputed relative for B		13.00/12.00=	1.083	
Indexes				
RAP	**100.0**	**103.9**	**106.9**	**117.6**
APR	**100.0**	**104.5**	**108.0**	**118.0**
GM	**100.0**	**104.4**	**107.7**	**117.3**
b) Impute using average price movement for other items in sample				
RAP				
Arithmetic mean price of A, C and D		13.33	13.83	
Imputed price for B		13.00x(13.83/13.33)=	13.49	
Index	**100.0**	**103.9**	**107.8**	**117.6**
APR				
Arithmetic mean of relatives of A, C and D		1.032	1.079	
Imputed relative for B		1.083x(1.079/1.032)=	1.132	
Index	**100.0**	**104.5**	**109.3**	**118.0**
GM				
Geometric mean of relatives of A, C and D		1.031	1.075	
Imputed relative for B		1.083x(1.075/1.031)=	1.129	
Index	**100.0**	**104.4**	**108.8**	**117.3**

CHOOSING AN INDEX NUMBER FORMULA

3.65 As different index number formulas will produce different results, there is a need for some ground rules to determine which formulas are more appropriate. Two main approaches have been used:

- the evaluation of the performance of the formula against a set of predetermined desirable mathematical properties or tests, the so-called 'axiomatic' approach
- economic theory.

Axiomatic approach

3.66 The use of tests to assess index number performance is a useful guide. However, a number of practical issues need to be considered. These include: how relevant are the tests for the application at hand; are some tests more important than others and, even if an index formula fails a test, how close in practice is the index likely to be to the 'best' measure.

3.67 The range of tests developed for index numbers has expanded over the years. Diewert (1992) describes 20 tests for weighted index formula, while Diewert (1995) provides 17 tests for equal weighted (or elementary) index formula and attributes the tests to their original authors. It is beyond the scope of this manual to describe all the tests, but several important and relevant ones for current purposes will be discussed.

3.68 Many of the tests apply to both the equal and unequal weighted formulas. The tests include:

- *Time reversal.* This test essentially requires that the index formula produces consistent results whether it is calculated going from period 0 to period 1 or from period 1 to period 0. More specifically, if the price observations for period 0 and 1 are interchanged then the resulting price index should be the reciprocal of the original index.[23]
- *Circularity* (often called transitivity). This is a multi-period test (essentially a test of chaining). It requires that the product of the price index obtained by going from period 0 to period 1 and from period 1 to 2 be the same as going directly from period 0 to period 2.[24]
- *Permutation* or *price bouncing*. This test requires that, if the order of the prices in either period 0 or period 1 (or both) is changed but not the individual prices, the index number should not change.[25] This test is appropriate in situations where there is considerable volatility in prices, for example because of seasonal factors or sales competition.
- *Commensurability*. This test requires that if the units of measurement of the item are changed (e.g. from kgs to tonnes), then the price index should not change.

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[23] If $I_{0,1}$ is the price index for period 1 using period 0 as the base and $I_{1,0}$ is the index for period 0 using period 1 as the base, then this test requires $I_{0,1} = 1/I_{1,0}$ or $I_{0,1}I_{1,0} = 1$.

Fisher (1922) refers to $1/I_{1,0}$ as the 'time antithesis' of the index formula.

[24] The concept of chaining has been outlined earlier in the section on 'Generating index series over more than two time periods'.

[25] A simple way to apply this test is to have the same prices in the two periods but change the order of the prices in the second period, in which case the index value should be 1.

- *Factor reversal test*. This test is not appropriate for the elementary index formulas. It requires that the product of the price index number for any period and an index of quantity obtained from the formula by interchanging the price and quantity terms should equal the ratio of expenditure in that period to the base period expenditure.[26]

3.69 The Fisher Ideal index formula passes tests on time reversal, circularity, commensurability and factor reversal, whereas the Laspeyres and Paasche only pass the test of commensurability.[27]

3.70 In regard to the three equal weight price index formulas discussed earlier, the APR fails the first three tests, the RAP fails the commensurability test while the GM approach passes all tests.[28] In terms of Diewert's 17 tests for elementary index formulas, the RAP passes 15 tests and the GM 16 tests.

3.71 While the equal weighted GM appears to have considerable appeal as an elementary index formula, there are some situations in which it produces an undesirable result. The GM cannot handle zero prices, which might occur if the government introduced a policy to fully subsidise a good or service. In addition, the GM may not produce acceptable movements when a price falls sharply. For example, consider a price sample of two items, each selling for $10 in one period, with the price of one of the items falling to $1 in the second period. The GM produces an index of 31.6 for the second period (assuming it was 100 in the first period), a fall of around 68 per cent. Because the GM maintains equal expenditure shares in each period, it effectively gives a larger weight to lower prices.[29]

3.72 Only in recent years has the GM formula become more widely accepted in official circles for compiling consumer price indexes. For example, Canada switched to using geometric means in the late 1980s, the United States introduced the GM formula for items making up about 61% of the CPI in January 1999 and Australia began introducing the formula in December quarter 1998. The GM formula is prescribed by the European Union for calculation of price sample means in its Harmonised Indices of Consumer Prices (HICP). There appear to be two reasons for the slow adoption of the GM. One is that prior to the use of computers in compiling the official indexes, calculation of geometric means was a very laborious task. A second reason is perceived difficulty in explaining the measure to users.

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[26] Fisher's (1922) factor antithesis is obtained by interchanging prices and quantities in the formula and then dividing this expression into the 'value ratio'. Diewert (1992, p. 222) notes that various researchers have objected to this test and does not count it in his list of 20 tests.

[27] Although neither the Laspeyres or Paasche index pass the factor reversal test on their own, the combination of a Laspeyres price index and a Paasche quantity index (or vice versa) will satisfy the test.

[28] Fisher (1922) summarised the poor performance of the APR approach in the following terms

"... the simple arithmetic average (APR) produces one of the very worst of index numbers. And if this book has no other effect than to lead to the total abandonment of the simple arithmetic type of index number, it will have served a useful purpose." (pp. 29–30).

[29] The RAP and APR formulas both produce an index of 55.

3.73 There is another aspect to indexes that is worth considering, although not rated as a test in the literature. In most countries the CPI is produced at various levels of aggregation, there typically being three or more levels between the lowest published level and the total all goods and services. In practice it is desirable that the same result is obtained whether the total index is compiled directly from the lowest level or in a staged way, using progressively higher levels of aggregation. Diewert (1978) shows that the fixed-weight Laspeyres and Paasche indexes have this 'consistency' in aggregation property, while the Fisher and Tornqvist indexes are (very) closely consistent.[30]

HANDLING CHANGES IN GOODS AND SERVICES

Quality change

3.74 A price index by definition measures what can be described as 'pure' price change, that is, it is not distorted by changes in 'quality'. The concept of a good or service within a price index is important in determining whether an item is 'new' or a modification (quality change) of a previous item. Under the usual index compilation practices, if the change in price of the item fully or partly reflects a change in quality, then for index purposes an adjustment may be necessary to account for that quality change. If it is a new item, then that item must be introduced into the index by linking (or splicing).

3.75 There are two main approaches to treating goods and services for the purposes of compiling a price index. The conventional or 'goods' approach is to treat each good and service as a separate item, for example a distinction might be made between red and green apples. The alternative approach could be termed a 'characteristics' approach that essentially 'breaks' actual commodities into their component characteristics or attributes which are valued by the consumer, which the consumer then combines to produce desired products. For example, the characteristics of an apple which households value might be its nutritional content plus the ability to consume without having to peform any food preparation. The outcome is that consumers satisfy their hunger.[31]

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[30] The aggregation property of the Laspeyres and Paasche indexes allows them to be broken down into points contributions which is very useful for analysing the relative significance of items in the index and their contribution to changes in the aggregate index. However, Diewert (2000) has produced an approach for similarly decomposing superlative index formulas.

[31] The characteristics approach to goods is the basis of the so-called 'household production theory'. The development of this theory is generally attributed to Lancaster (1966), Muth (1966) and Becker (1965). Bresnahan and Gordon (1998) also provide a good example in terms of household light, tracing the development from whale oil lamps through to the electric light bulb, pointing out how the additional inputs required on the part of households, such as trimming wicks etc.)were an important part in the production of light.

3.76 The characteristics approach provides a conceptual basis for describing quality change. In the sense of price indexes, quality can be thought of as embracing all those attributes or characteristics of an item on which the consumer places some value.[32] For example, in the case of apples, consumers will value them for nutritional content as well as taste and absence of blemishes/bruising. Unless an apple of the same quality is priced each period, then the price index will be biased. For some items quality change over time is not a major issue (e.g. the quality change in apples might only reflect differences in growing conditions between seasons) but for other items quality changes are very important (e.g. the increase in power and speed of personal computers, and changes in safety and ride quality of motor vehicles).

3.77 The characteristics approach has not been used to date as the sole basis of constructing a consumer price index. However, it is the foundation of the so-called 'hedonic' technique for estimating pure prices for commodities[33] and the hedonic technique is now being used by some countries in their CPIs for certain consumer goods.[34] Essentially the hedonic approach involves estimating a relationship between a commodity's price and the characteristics that it contains (e.g. in the case of personal computers, a relationship might be estimated between the price of the computer and its processing power (chip type and speed), amount of RAM, hard disk size, etc. over a range of computers). This effectively imputes a price for each characteristic that can be used to adjust prices as specifications change.[35]

3.78 Strict adherence to a 'goods' approach would see frequent linking in response to any change in the specifications of individual items priced. Frequent linking is undesirable as each link is effectively a break in the series and can introduce bias. In the absence of the hedonic approach, quality adjustments must rely heavily on subjective methods. In a consumer price index these adjustments should be based, as far as possible, on the value of the quality change to the consumer ('user value'). In this respect, use of manufacturing cost ('resource cost') data to value quality change can be misleading in many situations.[36]

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[32] Pollak (1983) identifies two characteristics approaches, that of Lancaster (1966) and Houthakker (1952). The Lancaster approach assumes that characteristics are additive across items (e.g. protein from meat can be added to protein from bread) whereas the Houthakker approach assumes characteristics are commodity specific.

[33] There are many examples in literature of the application of the hedonic technique, for example Ohta and Griliches (1975). For an overview of household production theory and the hedonic technique see Muellbauer (1974). Pollak (1983) provides an exposition on the treatment of quality in a cost-of-living index.

[34] For example, the hedonic technique is now used for estimating pure price change for personal computers and television sets in the United States CPI.

[35] It can be debated as to whether the increased speed and power of computers is reflected in corresponding increases in consumer utility, which raises questions as to whether the hedonic approach adequately captures quality change from a consumer perspective. However, studies have shown remarkable similarities in price indexes based on a hedonics approach and those for computers based on a comprehensive 'matched models' approach.

[36] This point and the use of characteristics space in compiling consumer and producer price indexes is explained in Triplett (1983).

3.79 While intuitively appealing, the successful application of the hedonic technique is not a trivial exercise. It requires substantial amounts of information and the careful selection of attributes that would be appropriate in a household utility function (e.g. if 'performance' is one characteristic of a motor vehicle that consumers desire, is engine power or acceleration speed or some other parameter the 'best' measure of performance). In addition there are issues such as the functional form to be used and weighting.[37] Nevertheless, the hedonic technique does provide a tool that may assist in identifying the price influencing characteristics of commodities and provides a basis for adjusting for quality change.

3.80 Recent research by Aizcorbe et al. (2000) has indicated that for high technology goods such as computers, the use of matched models and a superlative index formula captures the rapid quality change in these goods. This raises questions as to whether there is much to be gained by using a more complicated hedonic approach for some commodities.

3.81 It is not clear that prices should be adjusted for all changes in quality. An issue here is the appropriate treatment of mandated environmental measures, which increase the cost of items, such as pollution control hardware on automobiles. Mandated measures that (say) increase consumer safety can have a user value imputed to them, but the situation is not as simple for environmental measures. Indeed, Pollak (1989) argues that it is impractical to include environmental variables and produce meaningful price indexes.[38]

New goods

3.82 Prices statisticians are often confronted with the problem of determining when a new item on the market is a 'new good' for index construction purposes. A completely new good cannot easily be included in an existing price collection because there is no product category to which it can be readily classified. In such cases, it may eventually require its own separate recognition within the index rather than being a part of an existing product group.

3.83 The use of a hedonics or characteristics approach may assist in defining new goods. For example the hedonics approach might suggest that compact discs (CDs) were not actually new goods but rather a better bundling of musical recordings and other characteristics that people valued, such as a more durable media.

3.84 The difficulty of new goods is that they often show substantial falls in price once they gain market acceptance (sometimes after improvements in quality) and the supply of the good expands. There are two problems here. The first is that the traditional fixed-weight index does not allow for the introduction of new goods until weights are updated. The second is that if the new good is not included until some time after establishing a significant market share, then the initial price fall phase will be missed.

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[37] Current thinking as presented in Koskimaki and Vartia (2001) for example is that hedonic equations should have log price as the dependent variable and should be estimated for each period. The use of weighted regressions is also supported by researchers such as Diewert.

[38] In the United States the treatment of mandated anti-pollution devices has changed over the years. As from January 1999, modifications to goods and services solely to meet air quality standards have not been regarded as quality improvements, a practice that had previously applied since 1971. See Fixler (1998) for more information. In Australia, such modifications have always been regarded as price increases, not quality improvements.

3.85 It has been suggested (Hicks (1940), and Fisher and Shell (1972)) that, in a cost-of-living framework, new goods should be valued at their 'demand reservation' price. The demand reservation price is the intercept of the demand curve with the price axis, essentially the price at which no units of the good would be sold. However, procedures to reliably estimate the demand reservation price have yet to be established.[39]

BIAS IN PRICE INDEXES

3.86 Some of the issues on bias have already been covered above. However, it is useful to bring these matters together to further consider some practical issues involving price indexes, especially considering a major inquiry into the issue was held in the United States in 1996.[40]

3.87 A price index may be described as biased if it produces estimates which depart from the 'true' or 'correct' measure. In the case of consumer price indexes, the true measure is usually taken to be the cost-of-living index, as it allows for the substitutions in consumption that consumers make in response to changes in relative prices. As it is impractical to construct a true cost-of-living index, official agencies are forced into second best situations. However, if unwise practices are adopted, second best could turn out to be a very poor second best.

3.88 The following types of bias, typically upwards, have been described by Diewert (1996):

(i) elementary index bias, which results from the use of inappropriate formulas for compiling index numbers at the elementary aggregate level

(ii) substitution bias, arising from using formulas at levels above the elementary aggregates which do not allow for substitution in response to changes in relative prices

(iii) outlet substitution bias, when consumers shift their purchases from higher cost outlets to lower cost outlets for the same commodity

(iv) quality adjustment bias, which arises from inadequate adjustment for quality changes

(v) new goods bias, which arises largely from the failure to include new goods when first introduced into the market.

3.89 While it is almost impossible to eliminate these sources of bias, certain measures can be taken to minimise them. Some measures to minimise each of the sources of bias are:

(i) the use of appropriate formulas in compiling elementary aggregate indexes, in particular use of the GM formula where appropriate or the RAP formula

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[39] Hausman (1994) estimated that the US CPI price index for cereals was substantially overstated by not taking into account the gains in consumer surplus arising from the introduction of new varieties of breakfast cereals.

[40] This is often referred to as the 'Boskin Report', see Boskin (1996). Boskin estimated that the United States CPI was biased upwards by about 1.1 percentage points per annum. There were many submissions and views expressed about bias in the US CPI. For a semi-official perspective on the issue see Moulton (1996).

The ABS has not released any estimates of the magnitude of bias in the Australian CPI. However, the general feeling has been that bias in the Australian CPI would be significantly lower than in the US, in part reflecting differences in pricing and compilation practices.

(ii) use of a superlative type index formula rather than the Laspeyres, if current period weighting data can be obtained (on time). More frequent updating of weights in the Laspeyres formula is also suggested, although changing weights alone does not have a significant effect in the short to medium term unless the change in the weighting pattern is significant.[41] Other options might be to use formulas that allow substitution or assumptions about substitution between commodity groupings to be fed in

(iii) closely monitoring and updating price samples to reflect changes in the outlets from which households purchase. For example, looking ahead, there is clearly a need to plan for the inclusion in consumer price indexes of purchases from outlets operating exclusively over the internet

(iv) greater use of the hedonic technique to adjust for quality change and to determine comparable items

(v) the inclusion of new goods into the CPI as soon as possible. In the case of a fixed-weight index such as Laspeyres, there would also be a need to update the fixed weights to allow the inclusion of the new goods if they are substituting for all goods in general, or to adjust the weights within a commodity grouping if the new good is substituting for specific items (e.g. one could argue that CDs were a new good, but as they were substituting for records and tapes they could be introduced into the commodity grouping for records and tapes and weights between these items adjusted accordingly).

CONCLUSION

3.90 Price index theory provides prices statisticians with guidance as to the best practices and formulas to use in compiling price indexes in order to produce reliable price measures. However, the highly desirable must be balanced against the practical — it would be highly desirable to use a superlative index formula such as the Fisher ideal for all price indexes, but timeliness issues and data availability preclude this.

3.91 There is much more to a price index than which formula to use. Also important is the determination of what items are to be included in the index, i.e. the index domain.

[41] As noted earlier, the issue of frequency of reweighting or chaining is somewhat vexed. In a situation of price bouncing, chaining can introduce substantial bias into index formulas (see for example Szulc (1983)). In general, chaining more frequently than annually, even if feasible in practice, could introduce bias.

CHAPTER 4 CONSUMER PRICE INDEXES

INTRODUCTION TO A CONSUMER PRICE INDEX

4.1 This Chapter looks more closely at the concept of a consumer price index.[42] The conceptual basis is important in determining the items that are in scope of the index, their weights and pricing. The previous Chapter provided theoretical background as to how this information is brought together to compile the index numbers.

4.2 As the title suggests, a consumer price index measures the change in prices paid by households for goods and services for consumption purposes. All expenditures by businesses and expenditures by households for investment purposes are out of scope of a consumer price index. In this regard, expenditure on housing presents particular difficulties as it can be considered as part investment and part purchase of shelter-related services.

4.3 While in principle the make-up of a consumer price index seems relatively straightforward, it is less so in practice. A starting point is to address the question of what is the principal purpose of the index. There are three principal purposes identified in this Chapter and the implications of each for index construction are discussed. Other issues are also considered, including the population and the geographic coverage of the index.

DEFINING A CONSUMER PRICE INDEX

4.4 There is currently no single universally accepted definition of a consumer price index. The typically quoted description of such an index is the following statement from the 'Resolution concerning consumer price indices' released in 1987 by the Fourteenth International Conference of Labour Statisticians convened by the Governing Body of the International Labour Organization (ILO):

> "The purpose of a consumer price index is to measure changes over time in the general level of prices of goods and services that a reference population acquire, use or pay for consumption. A consumer price index is estimated as a series of summary measures of the period-to-period proportional change in the prices of a fixed set of consumer goods and services of constant quantity and characteristics, acquired, used or paid for by the reference population. Each summary measure is constructed as a weighted average of a large number of elementary aggregate indices. Each of the elementary aggregate indices is estimated using a sample of prices for a defined set of goods and services obtained in, or by residents of, a specific region from a given set of outlets or other sources of consumption goods and services."

4.5 The Resolution is currently being reviewed by the ILO. Nevertheless the Resolution effectively suggests three bases on which to compile a consumer price index, namely: the consumer goods and services that were acquired (or taken ownership of); the actual amounts paid (or outlaid) to gain access to consumer goods and services; or the consumer goods and services which were used up (or consumed). All three are measured in the base period. The differences in these conceptual bases will be described later in the Chapter. Which of these approaches is employed should be appropriate to what is determined to be the principal purpose for which the index will be used.

[42] Issues are examined from a conceptual perspective. The extent to which concepts can be, or are, implemented in practice is not considered in this Chapter.

HOUSEHOLD ACCOUNTS AND A CONSUMER PRICE INDEX

4.6 Consideration of the types of transactions undertaken by households provides a framework for clarifying the domain of a consumer price index.

4.7 Households derive income from various sources including wages and salaries, investment returns and sale of assets. The income received (net of taxes on income) is spent on goods and services, or saved (where saving includes the purchase of assets). Essentially a consumer price index is concerned with the outlays component of the household account. The following table illustrates a household account, showing the types of incomes and outlays essential to the discussion.

4.1 TRANSACTIONS OF THE HOUSEHOLD SECTOR

Income and Outlays	
Income	
	Wages and salaries
+	Government benefits
+	Income from assets (interest, dividends, rent)
+	Insurance claims
–	Taxes
=	Total available income
Outlays	
	Rent
+	Private sector goods and services
+	Government goods and services
+	Insurance premiums
+	Property purchase (residential, shares, bonds etc.)
+	Interest on debt
+	Savings (balancing item)
=	Total outlays
Balance Sheet	
Assets	
	Cash
+	Property (real and financial)
=	Total
Liabilities	
	Debt

4.8 The value of the transactions will reflect the actual payments made, or committed to be made, on the purchase of goods and services. Irrespective of whether an item is purchased on credit or paid for in cash, the full value of the item is recorded in the accounts. In an accrual accounting model, the time of recording the transaction is the period in which the change of ownership occurs rather than when the payment is made (in practice they will generally coincide). While most outlays will be valued at market prices, some will be at subsidised prices (e.g. public education, medical services).

4.9 As an index is typically constructed for a group of persons or households, the accounts of those individual persons or households must be added together. There are some results of the consolidation process that should be noted, in particular the treatment of transactions in second-hand goods between households.

4.10 In the accounts of an individual household, the purchase of an existing item (e.g. motor vehicle) from another household would be shown as an outlay. It would also be shown as a negative outlay (i.e. a receipt or 'income') in the account of the selling household.[43] As a result, in the accounts of the household sector as a whole, such a transaction would not be shown – it would 'net' out because the expenditure by the purchasing household is negative expenditure by the selling household. However, if such a transaction occurred through a second-hand dealer, then the dealer margin (not the full price of the second-hand good) would be included in the outlays of the household sector since this is expenditure by households that is income in another sector's accounts.

4.11 The situation becomes more complicated when the transactions are between the household and non-household sectors of the economy. If the second-hand good was previously owned by another sector of the economy, then the full sale price of the good would be shown as an outlay by the household sector. On the other hand, the value of any sale of second-hand goods by the household sector to the non-household sector would be deducted from the outlays of the household sector.

4.12 Another feature of household accounts that generally carries across to consumer price indexes is the treatment of repayments of principal. Regardless of the method of financing any purchase or acquisition, the expenditure that is recorded on an item is its full purchase price. Any repayment of principal associated with borrowed funds to finance the purchase of an item is excluded, because including principal repayments would result in double counting.

PRINCIPAL PURPOSE OF A CONSUMER PRICE INDEX

4.13 A consumer price index may serve various purposes. However, three principal purposes are generally recognised, namely to measure:

- changes in the purchasing power of money incomes
- changes in living standards
- price inflation for the household sector.

Purchasing power of money incomes

4.14 A CPI designed for measuring the purchasing power of money incomes is concerned with answering questions like 'how much income would be required today to purchase the same basket of goods and services purchased in the base period'.[44] The appropriate domain of the basket in this case is all those outlays on consumer goods and services actually made by households in the base period. In terms of the household account framework, savings (and the use of savings to purchase assets) could be treated as foregone consumption. Thus savings can be excluded from the item coverage.

[43] Households often trade in an existing good to buy the new good. In the individual household account the outlay on the good would be shown as the new good price less the price received for the sale of the old good.

[44] This presentation is consistent with an index formulation that uses fixed-base period weights. It is simpler than a cost-of-living index framework. A cost-of-living approach estimates the change in expenditure required to maintain a household at the same level of utility or satisfaction in the reference and comparison periods. For a discussion of the cost-of-living approach see Triplett (1999).

4.15 In the above context, the correct measure of income on which to base the assessment is net income (after income tax), not gross income. Application of the index to gross income is only valid if income tax is proportional to income and the treatment of property income is identical to that of wage and salary income. A progressive income tax regime such as that applying in Australia emphasises the need to use net income. Further, as the relative significance of different sources of income and expenditure varies considerably between household types, changes in purchasing power are best assessed at a disaggregated level, rather than the 'all household' level.

Assessing changes in living standards

4.16 In assessing changes in living standards, the CPI is used in conjunction with data on expenditures by households to measure changes in their volume of consumption of all goods and services.

4.17 An initial issue is to define 'standard of living'. A narrow definition of standard of living is that it includes the volume of goods and services actually consumed by households in the base period. For many consumer items, the acquisition of, the payment for, and the consumption of the item occur at about the same time. However, for some items the volume of the item consumed in a period may have little relationship to the payments made in the period. Typical examples are durable items (e.g. private motor vehicles, where the vehicle may have been purchased several years earlier), financial charges (e.g. insurance premiums which cover claims payments as well as the insurance service, or interest charges, which provide compensation to depositors as well as covering the service costs of the financial intermediary). For other items the price is substantially below the 'true' or economic cost of providing the good or service, so that expenditure is not a reflection of the quantity of the item consumed. Typical examples are various services provided by the public sector (e.g. education and medical care). Estimates must be made of the economic value of these items actually consumed in the base period.

4.18 In the case of durables, estimates of the market value of consumption can be made by reference to market prices (such as rents in the case of owner-occupied dwellings and leasing charges for motor vehicles[45]). In the case of financial services, estimates of the service component (essentially operating costs plus profit) must be derived from accounts of relevant companies. In the case of public sector goods and services, reference can be made to comparable private sector charges where applicable or estimates can be based on the cost of service provision (e.g. teachers' salaries plus building and running costs in the case of education).

4.19 A wider definition of living standards could be envisaged. It might include environment related living conditions, such as the quality of air and water, or the area of national parks. While such conditions are important in their own right, the measurement of these factors, the values placed on them by households and the means of including them in a price or living cost index are as yet insoluble problems (see Pollak (1989)). For current purposes the narrow definition will be retained.

4.20 Against this background, the domain for an index designed to assess changes in living standards would include:

- residential rent payments
- imputed rent on owner-occupied dwellings

[45] If leasing charges are used to value the volume of service consumed, then certain vehicle charges such as registration and vehicle servicing would not be included separately in the domain as they would be covered by the leasing charges.

- consumer durables
- private sector goods and services (other than financial services and durables)
- the service value of financial services (insurance and banking)
- government-provided goods and services valued at cost or at market prices.

4.21 This measure accords quite closely to the concept of household final consumption expenditure in the national accounts.

Measuring household inflation

4.22 The objective of the CPI in this case is to obtain a measure of price inflation facing households as consumers. Such a measure is primarily for use in macroeconomic management and also has some possible uses in contracts where an index of prices of household consumption items is appropriate. It should be noted that this is not a measure of economy-wide inflation, as it only relates to household expenditures.

4.23 There is no generally agreed definition of 'inflation', which complicates the issue of how it should be measured. Nevertheless, some aspects are suggested. A measure of household inflation should relate to the contemporary rate of change in prices of goods and services. For example, this would exclude interest rates, as interest rates are not prices in the same sense as are prices of particular goods. Rather, interest rates represent the price of money, or more correctly, the relative price of consuming goods and services today rather than in the future.

4.24 An important aspect of an inflation measure is that it should only include 'actual', or market-determined prices. Thus an inflation measure would not include imputed rent on owner-occupied dwellings. A measure of house prices would be more appropriate if housing is not considered an investment. Financial assets would not be considered a good or service so that prices of shares and the like would be out of scope. However, such a measure would need to capture changes in the service charges of intermediaries involved in financial and asset transaction services, such as banks, insurance companies and real estate agents.

4.25 Ideally, such an inflation measure should also exclude goods and services provided to households at subsidised prices. The subsidised prices do not reflect the true market price (or economic value) of the goods and services. The treatment of taxes and subsidies (which are negative taxes) should be symmetric. However, this would lead to some significant goods and services (for instance, education) being omitted from a CPI that would otherwise be considered essential for complete coverage. Consequently, the most common practice is to include these subsidised goods and services.

4.26 The domain for a measure of household inflation would thus include:

- residential rent payments
- net purchase of owner-occupied dwellings
- net purchase of consumer durables
- goods and services provided at market prices (other than financial services and durables)
- the value of intermediary services involved in financial and asset transaction services (e.g. insurance, banking and stockbroking services).

COMPARING INDEX OUTCOMES BY PURPOSE OF INDEX

4.27 The purpose the CPI is to serve, should clearly play a dominant role in determining the domain of the index. No one domain can adequately serve all purposes for which the index might be employed. The following example from Woolford (2001) indicates how the results of various price changes would be reflected in indexes constructed according to the above three purposes:

> "Consider the case of a subsidised commodity and a change in government policy that reduces the level of subsidy, all other things being equal. A living standards index would record no change, as there has been no change in the economic price (or value) of the commodity concerned. The money income evaluation measure would record a price increase reflecting the fact that households are now required to pay more out of their own pockets. The ideal inflation CPI would also show no change, as the item would be excluded.
>
> Consider the case when the only prices to increase are those for dwelling rents. The living standards index would record a higher rate of increase than either of the other two, reflecting the fact that this index assigns a larger weight to dwelling rents to cover the value of the flow of housing services enjoyed by owner occupiers.
>
> Finally, consider the case of so-called 'income dependent' prices, that is prices that depend, at least to some extent, on the income of the purchasing household. Now, assume that the only change in actual transaction prices between two periods can be attributed to changes in household incomes. With no change in the economic value, the living standards index should show no change. The income evaluation index should record the increase. To the extent that this pricing mechanism is generally used to implement a subsidy programme, then an ideal inflation index would exclude the item."

CONCEPTUAL APPROACHES TO CONSTRUCTING A CPI

4.28 Once the purpose of a CPI has been determined, a method of construction can be identified to satisfy that purpose. Consistent with the three purposes outlined above, there are three alternative conceptual approaches for constructing a CPI. These approaches fall into line with the ILO description of the purposes of a CPI in terms of changes in prices of goods and services whereby "...a reference population **acquire**, **use** or **pay** for consumption".[46] The three methods are:

(i) *The Acquisitions method*: in the base period, any goods and services acquired (actually received) by the reference population — regardless of the period in which payment or use occurs — are included in the CPI.

(ii) *The Outlays method*: in the base period, any goods or services for which payments were made to gain access to goods and services (without regard to the source of such funds).

(iii) *The Cost of Use method*: in the base period, any goods and services used (consumed) by the reference population, regardless of when they are paid for or acquired, are included in the CPI. In particular, the cost of using the good or service is measured by its 'true' or 'economic' cost.

4.29 The acquisitions and outlays approaches are very similar. The acquisitions approach leads to a CPI basket that can be viewed as a subset of the basket resulting from an outlays approach. Both conceptual approaches include goods and services acquired during the base period, while the outlays approach also effectively includes any inescapable costs associated with the acquisition of a good or service, such as interest charges. The cost of use approach can result in a basket that differs from both the acquisitions and outlays approaches.

[46] ILO (1989) page 4.

4.30 The choice of conceptual approach for construction should depend on which approach is most appropriate for the purpose. The approach to construction that is most appropriate for each of the three possible CPI purposes is outlined below:

(i) *Measuring household sector inflation.* In this case the acquisitions method is the most appropriate. A measure of household sector inflation should relate to the contemporary rate of change in prices and services. The acquisitions approach captures this, by measuring changes in the prices of goods and services actually acquired in the base period.

(ii) *Purchasing power of money incomes.* In order to determine changes in the purchasing power of money, an outlays approach would be most appropriate. The outlays approach would provide a proxy for household income through measurement of consumer outlays.

(iii) *Assessing changes in living standards.* The cost of use approach provides the best indication of changes in living standards as it relates to goods and services actually consumed in the base period.

COMPARISON OF THE CONCEPTUAL APPROACHES

4.31 In practice, for most goods and services purchased by the reference population, outlays, acquisition and use all occur within a relatively short space of time and the price paid by the reference population represents a 'true' value, effectively making the distinction unimportant. In some cases however, there can be significant lags between outlays, acquisition, or use or the price paid may differ significantly from what is considered the 'true' value.

4.32 There are three areas of expenditure in which these conceptual approaches provide significantly different results. These are:

(i) purchase of dwellings

(ii) purchase of durable items

(iii) financial services and the use of credit.

4.33 To illustrate the differences, the way in which these three special cases are treated under each approach is outlined below.

Expenditure on housing

4.34 Under the acquisitions approach, the required measure is the change in prices for both the net purchase of housing, and the increase in volume of housing due to renovations and extensions, plus other costs incurred in ensuring the continued supply of services provided by the dwellings (e.g. maintenance costs and council rates) for owner-occupied housing. Changes in the rental are measured for that part of the reference population that resides in rented dwellings (costs such as maintenance on these dwellings are paid by investors who are out of scope of a CPI).

4.35 Under the outlays approach, the required measure includes changes in the amount of interest paid on mortgages and the costs incurred in ensuring the continued supply of services provided by the dwellings (e.g. maintenance costs and council rates). Again, also included are changes in the rental, which is measured for that part of the reference population that resides in rented dwellings.

4.36 Under the cost of use approach, the required measure is the change in the economic value of the services provided by dwellings. The price of these services is usually measured as the rental value of the dwellings. In the case of owner-occupied dwellings, the rental values are imputed. Costs such as maintenance costs are not included as they are part of the cost of maintaining an investment and so are outside the scope of a CPI.

Durable goods

4.37 In the case of durable goods, the three approaches result in the following treatments:

(i) Acquisitions — the basket includes those durable goods acquired in the base period and their price measure is the transaction price.

(ii) Outlays — the basket includes those durable goods paid for in the base period and their price measure is the transaction price.

(iii) Cost of use — the basket includes the services of durable goods consumed in the base period, regardless of the period in which they were purchased and the price measure is the market value of the services provided by those goods (measured in business accounts as depreciation plus the return on investment).

Financial services and the use of credit

4.38 Under the acquisitions approach, interest paid is not a charge that is within scope of the CPI basket of goods and services. The service for which prices are required is the service of providing the various banking services (including the provision of loans).

4.39 Under the outlays approach, the product being priced is the cost of servicing all loans taken out to purchase products that are part of the CPI basket. Thus the change in the level of interest paid on a real level of debt is the required price measure.

4.40 The cost of use approach requires that the cost of the financial services used is measured, similar to the acquisitions approach.

Concluding remarks

4.41 Although these alternative approaches to the construction of a CPI are characterised by conceptual differences, they are more likely to result in short-term rather than long-term differences in outcomes (particularly in the case of the acquisitions and outlays approaches). In the long-term, the outcomes are expected to be similar. In practice, each approach covers a broad range of consumer goods and services, which tend to have similar long-term price behaviour in the absence of external shocks or institutional change. In addition, there is a large set of components common to all three approaches.

CPI ITEM COVERAGE

4.42 The set of goods and services included in a CPI is said to be its item coverage, or more commonly, the CPI 'basket'. In concept, all consumer goods and services are within scope of the index. However, the coverage will vary somewhat as discussed above depending on the principal purpose of the index. Also, if an index is compiled for a subgroup of households, it is possible that their expenditures on some commodities may be nil, but conceptually the item will be in scope.

4.43 There are certain exclusions and inclusions that are relevant to any CPI basket. These are covered below.

Business, savings, and investment related purchases

4.44 As a general principle, a consumer price index only includes consumption goods and services purchased by households. A consumption good or service is basically one from which households directly derive utility or satisfaction. Any business-related purchases are excluded from the basket, as are those items that have a significant savings or investment component, such as land or capital goods. All types of income are also excluded from the basket (except those which directly offset a specific purchase, such as subsidies or trade-ins).

Taxes, levies, concessions & subsidies

4.45 The prices of consumer goods and services and the ability of households to purchase those items are affected by a wide range of government taxes, regulatory processes and assistance measures. The treatment accorded such distortions under the acquisitions and outlays approaches are similar, but there are differences to a cost of use approach.

4.46 As a general principle, the acquisitions and outlays approaches only include government taxes, subsidies etc. whenever such measures are tied to the level of consumption of a specific good or service. Thus any taxes based solely on income will generally be out of scope, whereas the prices of goods and services will be inclusive of indirect taxes and any commodity specific subsidies. In some cases government taxes and charges may not be directly related to the level of consumption of a good or service but may still be included as they are an inescapable cost of other consumption decisions (e.g. local government rates and charges are an inescapable cost of home ownership).

4.47 A cost of use approach is concerned with the true value of goods and services consumed. For example it will value subsidised items at their comparable market value. It will also exclude income taxes (see Chapter 7 for more information).

Second-hand goods

4.48 As noted earlier, in concept both the purchases and sales of second-hand goods should be included in a CPI. The purchases of second-hand goods by households are regarded as positive expenditure and sales by households as negative expenditure. The exact treatment of second-hand goods will also depend on the nature and extent of transactions with non-household sectors. (see Chapter 7 for more information).

Illegal or 'undesirable' goods

4.49 As a general principle, all purchases of goods and services for consumption are in scope of a CPI. They include goods or services that are either illegal or may be considered socially 'undesirable', such as alcohol and tobacco, gambling, prostitution, and illicit drugs. Decisions regarding the composition of the basket should not be based on moral grounds.

Geographic coverage

4.50 All price indexes have a geographic or regional dimension, such as the price index for a specific city or country. A further aspect to the geographic coverage that is important for price collection for a consumer price index is whether the objective is to measure price changes for:

- a set of goods and services *obtained in* a particular region
- a set of goods and services obtained by *residents of* a particular region.

(A region can be any geographic entity, such as rural areas, city, state or country.)

4.51 If the index is to measure the prices of items obtained in a region then the 'basket' will comprise all consumer goods and services purchased in that region by households for final consumption. These purchases can be made by households that are residents of that region or visitors to the region (including from overseas) and will include purchases by households in other regions made over the Internet or by mail order. If the index is to measure prices of items obtained by household residents of the region, then it will comprise all consumer goods and services purchased by those households regardless of the geographic region from which they were purchased. In addition to purchases made in that region, it will include any purchases these households make whilst visiting other domestic regions or foreign countries as well as items ordered from outside the region over the Internet or by mail order.

4.52 The geographic dimension becomes more important the smaller the region to which the index relates.

CPI reference population

4.53 The expenditures or weights applied to the index basket reflect expenditures of a certain 'reference population'. Typically the basic unit of reference population is households.[47] The household is an appropriate unit since many items are jointly consumed by all members of the household, such as food, motor vehicles and housing, and it is not sensible (or possible) to determine an expenditure for each individual.

4.54 A consumer price index can be constructed for all households or a subset of households (e.g. age pensioners, wage and salary earners, retirees). Even if the purpose of a CPI requires the broadest possible reference population, certain types of individuals whose consumer expenditures are minimal may be excluded, for example those living in institutions such as hospitals, barracks, prisons, and on board ships.

WEIGHTING THE INDEX

4.55 The overall CPI provides a measure of the average rate of price change across all consumer goods and services. In calculating an average of price changes across these items it must be recognised that some are more important than others in terms of their share of household expenditure (or weight). For example, if household expenditure on bread was three times as large as expenditure on cheese, then a 10% increase in the price of bread should have a similar impact on the CPI as a 30% increase in the price of cheese. Thus the aggregate index should be compiled by weighting price movements relative to their importance in the overall expenditure levels of households. The reference period for the expenditure data would depend on the chosen index formula. For instance, a Laspeyres formula would require expenditure data from the initial period while a Paasche formula would require data for the current period.

4.56 Expenditure of the reference population is usually measured over a year to obtain the reference data. Doing this overcomes any problems that might arise from seasonal changes in expenditure (e.g. different types of clothing and foods purchased in suimmer and winter).

[47] A household is a group of people who usually reside and eat together. This may be a one person or a multi-person household.

CHAPTER 5 THE AUSTRALIAN CPI

INTRODUCTION

5.1 This Chapter provides an overview of the Australian CPI, largely in the context of the theoretical and methodological issues outlined in Chapters 3 and 4. More detailed information on practical matters is provided in subsequent Chapters.

5.2 The principal purpose of the Australian CPI is discussed, followed by a description of the features of the index, its conceptual basis, coverage, structure, weighting and the price index formulas employed.

PRINCIPAL PURPOSE AND USES

5.3 The Australian CPI is specifically designed *to provide a general measure of price inflation*[48] *for the household sector as a whole*.[49] It measures changes over time in the prices of consumer goods and services acquired by Australian households.

5.4 The use of the CPI is appropriate in circumstances where a measure of general price inflation is required. A major role of the index is as an input to the conduct of general economic policy, in particular monetary policy by the Reserve Bank of Australia (RBA). Since 1993, monetary policy has been conducted with the aim of meeting a medium-term inflationary target. Since the introduction of the 13th series CPI in the September quarter 1998, that target has been the CPI.[50,51]

5.5 The CPI, or one of its components, is widely used in indexation arrangements of both the private and public sectors. These include indexing various pension and superannuation payments, taxes and charges, indexed government bonds and business contracts. Specific uses of the CPI are discussed in more detail in Chapter 10.

5.6 The role of the CPI in wage determination processes has diminished with the trend towards decentralised, enterprise level wage and salary setting arrangements with outcomes focused on the commercial circumstances of individual businesses.

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[48] Although there is no universally agreed definition of inflation, it is typically described as the phenomenon of an increase in the general level of prices over time. Strictly speaking the CPI measures price change, that is, both rises and falls in prices.

[49] A fundamental change was made in the principal purpose of the CPI with the introduction of the 13th series in the September quarter 1998. Prior to this period, the principal purpose of the CPI was as an input to wage determination processes. After extensive public consultation for the 13th series CPI review, it was determined, on balance, that the needs of the Australian community would best be served by changing the principal purpose to a measure of price inflation. In practical terms, the major effect of this change was dropping interest charges and including house purchase in the CPI. For further information refer to *Information Paper: Issues to be Considered during the 13th Series Australian Consumer Price Index Review*, (cat. no. 6451.0) and *Information paper: Outcome of the 13th Series Australian Consumer Price Index Review*, (cat..no.. 6453.0).

[50] Between 1993 and the introduction of the 13th series, a subset of the CPI was used as the target. Commonly referred to as the 'Treasury measure of underlying inflation', this index excluded items from the CPI that were considered by the Treasury and RBA to be unrepresentative of the 'core' or underlying rate of inflation in that their prices were highly volatile, exhibited marked seasonal patterns or were largely affected by policy decisions.

[51] For a discussion of the use of the CPI in the conduct of monetary policy, refer to the *Reserve Bank Bulletin* (October 1998) article 'The Implications of Recent Changes to the Consumer Price Index for Monetary Policy and the Inflation Target'.

5.7 Consistent with the purpose of measuring household inflation, the approach adopted in constructing the Australian CPI is the acquisitions approach. As noted in Chapter 4, the acquisitions approach encompasses market transactions in goods and services only, and excludes additional indirect costs associated with the acquisition of specific goods or services, such as interest charges. Hence the CPI measures the price change for goods taken possession of and services taken delivery of, by the reference population, in the base period.

5.8 In the 13th series CPI review, the ABS recognised that, while the community was best served by changing the principal purpose of the CPI to measuring price inflation, there was an ongoing demand for indexes for the purposes of assessing changes in living costs. Further, there was a demand for indexes for subgroups of the population. Accordingly the ABS committed to prepare such indexes for selected household types using an outlays approach.[52] The first release was in 2001 and these series are updated annually.[53]

MAIN FEATURES OF THE AUSTRALIAN CPI

5.9 The Australian CPI is a measure of 'pure' price change (i.e. price change excluding the effects of any change in quality or quantity of the goods or services concerned). The objective is to measure the change each quarter in the price of an identical basket of goods and services. The basket of goods and services is defined in terms of annual expenditures in the base year.

5.10 The Australian CPI is a measure of changes in transaction prices — the prices actually paid by consumers for the goods and services they buy (provided there are sufficient supplies of a product, which rules out 'run-out' priced goods and damaged goods). It is not concerned with nominal, recommended, or list prices. As such, a considerable amount of CPI price collection work goes into measuring actual transaction prices.

5.11 The Australian CPI measures price change over time and does not provide comparisons between relative price levels at a particular date, either between products or regions. For example, it does not tell us whether beef is dearer than lamb or whether bus fares are more expensive than train fares. The fact that the index number for any particular item is higher than that for another item in a particular quarter does not mean that the first item is more expensive than the second. Rather, it means that since the base year, prices for the first item have risen more than prices for the second.

5.12 Similarly, the CPI does not provide any basis for measuring relative price levels between different cities. If the index number for a particular city is higher than the index number for another city, this means that prices in that city have risen relatively faster since the reference base year rather than that city having a higher relative price level.

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[52] See paragraph 26 of *Information paper: Outcome of the 13th Series Australian Consumer Price Index Review* (cat. no. 6453.0).

[53] See 'Analytical Living Cost Indexes for Selected Australian Household Types', *Australian Economic Indicators*, June 2001 (cat. no. 1350.0).

The reference population

5.13 The reference population for the Australian CPI is *all private households in the eight capital cities.* The eight capital cities include the six state capitals, Canberra and Darwin. This is referred to as *the CPI population group* and it represents approximately 64 per cent[54] of Australian private households. Ideally the CPI population group should encompass all Australian households, but this is not feasible due to the substantial additional resources that would be required to collect prices outside the capital cities.[55]

5.14 Not all people are part of a private household, that is, reside in private dwellings. Examples of non-private dwellings include hotels, boarding houses and institutions such as gaols and university residences. Expenditure by persons who reside in non-private dwellings is excluded from the CPI. However these persons represent only a small percentage of the total population.

Commodity coverage

5.15 Ideally, all expenditures on consumer goods and services by the CPI population group should be covered in the index. While most expenditures are included, the more important exclusions and reasons for exclusion are summarised below:

- *Gambling.* It is difficult to establish the service or utility that households derive from gambling and thus to determine an appropriate price measure.
- *Financial services other than general insurance.* This encompasses a range of services, such as those associated with deposit and loan facilities offered by financial intermediaries, broking and real estate services, currency exchange, legal and accounting services and superannuation fund services. These services are typically complex to price and suitable data are not readily available for some.[56]
- *Illicit drugs.* It is difficult to obtain reliable estimates of either prices or expenditures.

5.16 Households acquire a large number of different goods and services. It is not practical or necessary to price all the goods and services acquired by the CPI population group. Many related items are subject to similar price changes and households acquire more of some items than others. Rather, the items selected for pricing in the CPI are the more significant ones and are likely to have price movements that are representative of a wider range of goods and services.

5.17 Items are selected using purposive (or judgmental) sampling. To be included in the basket, goods and services must be representative of purchases made by the CPI population group and have prices that can be associated with an identifiable and specific commodity. Items are not excluded from the CPI basket on the basis of moral or social judgements. Some commodities that may be considered socially undesirable (e.g. tobacco) are included in the CPI basket because they are significant items of household expenditure and their prices can be accurately measured.

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[54] Source: *Household Expenditure Survey, Australia 1998–99* (cat. no. 6530.0).

[55] In addition, information would be required on the locations where the households purchased the goods and services (often referred to as 'point of purchase').

[56] The ABS is currently (2003) concentrating efforts on developing measures for deposit and loan facilities and real estate.

Geographical coverage

5.18 The CPI is compiled separately for each capital city. For general statistical purposes the equivalent of an *all Australia index* is the series published as the *weighted average of eight capital cities.*

5.19 The geographical coverage of each capital city index is the acquisitions of goods and services by the resident population of that city. Hence, in concept the CPI includes all acquisitions by capital city residents, from outlets in their capital city, other capital cities and regions of Australia and abroad.

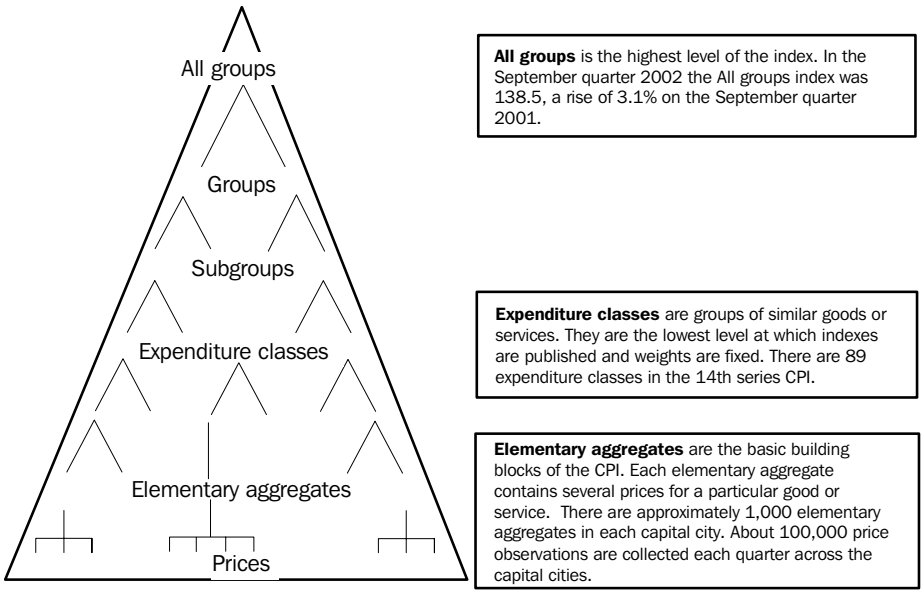
5.20 By and large, it is expected that most of the acquisitions made by households in the capital cities will be from providers of the goods and services that are located in the same city. The most obvious exception is holiday accommodation services. The acquisition of goods by mail order or over the phone or internet from outlets within and outside the capital city of residence is considered to be relatively small.

5.21 For the main part the CPI captures expenditures of capital city households regardless of where those expenditures are incurred. However, for pricing purposes, it is only domestic holiday accommodation for which prices are included from outside the capital city of residence of the household.

STRUCTURE OF THE AUSTRALIAN CPI

5.22 A diagrammatic overview of the structure of the CPI is provided in figure 5.1. The structure of the CPI can best be thought of from a top-down approach. At the top is the total expenditure or pool of items purchased (the All groups level). This is progressively divided into finer commodity groupings until, at the lowest level, there are samples of prices for the individual items (elementary aggregates). Indexes are only published down to the expenditure class level as this is the level at which the structure and weights are fixed for the life of a CPI series.

5.1 CPI STRUCTURE



5.23 This same structure is used for each of the eight capital cities. A full list of groups, subgroups and expenditure classes is provided in the Appendix.

5.24 The division of the items into finer product groupings, is intended to reflect increasing levels of substitutability of the items in consumption by households in response to changes in relative prices. For example, at the group level there is likely to be little substitution between, say, food and transportation groups in response to changes in their relative prices. Within the Fats and oils expenditure class it would be expected that households are more likely to substitute between, say, margarine and butter in response to changes in their relative prices.

5.25 The structure of the Australian CPI in large part follows that of the Classification of Individual Consumption by Purpose (COICOP) which is the basis of the European Union's Harmonised Indices of Consumer Prices (HICP).[57] However there are some important differences.

5.26 The 14th series CPI basket is divided into 11 major groups, each representing a specific set of commodities:

- Food
- Alcohol and tobacco
- Clothing and footwear
- Housing
- Household furnishings, supplies and services
- Health
- Transportation
- Communication
- Recreation
- Education
- Miscellaneous.

5.27 These groups are divided in turn into 34 subgroups, and the subgroups into 89 expenditure classes.

5.28 Presentation of the CPI in the form of groups and subgroups provides the user with quite a degree of versatility in interpreting the results. Index numbers for individual groups and subgroups can be analysed separately as can their individual effects on the overall index.

5.29 The All groups index represents the highest level of the index and it is commonly referred to as the 'headline' rate of inflation.

WEIGHTING THE INDEX

5.30 The overall (or All groups) CPI is compiled by weighting price movements (or price relatives) between the base and current period by their shares of total household expenditure in the base period. The aggregate index is compiled by weighting price movements (or price relatives) between the base and current period by their shares of total household expenditure in the base period. This is simply the alternative way of calculating a Laspeyres index as described in paragraphs 3.24 and 3.25.

[57] For information on the HICPs, refer to *Report from the Commission to the Council on Harmonisation of Consumer Price Indices in the European Union*, Eurostat, Catalogue number KT-CO-00-176-EN-C.

5.31 In practice the CPI is compiled using 'expenditure aggregates' rather than expenditure shares. The expenditure aggregate for an item in period t is calculated by multiplying the base period expenditure aggregate ($p_0 q_0$) by the price relative for period t (p_t / p_0). In effect this is simply the product of the (unobserved) base period quantity and the period t price. Summing the expenditure aggregates in period t and dividing by the sum of the expenditure aggregates in the base period yields the Laspeyres price index.

5.32 Hence the CPI is described as measuring the change over time in the total price of a fixed basket of goods and services purchased by households in aggregate. It is important to note that the use of the term 'fixed' relates to the quantities underlying the base period expenditures — it is, after all, the base period quantities that are fixed in a Laspeyres index. Weights are usually expressed in terms of expenditure shares because quantities are not meaningful or consistent across commodities and services. Further, the expenditure shares will change over time as the rate of price change varies across commodities.

5.33 The description of the CPI as a fixed-weight index requires qualification reflecting the practices adopted by ABS.

5.34 Holding the weights of goods and services in the CPI basket fixed permanently is neither realistic nor entirely possible. If held constant on a permanent basis, the weights would become less representative of the relative importance of goods and services purchased by households the further the series moved away from the base period. There would also be the problem of items that cease to exist and the entry of new goods and services. Furthermore, the finer the level of detail the less information that exists about the relative importance of items in the basket, which makes it difficult to calculate weights at lower levels of the index.

5.35 To reduce these problems, weighting practices vary by the level of aggregation:

- At the published levels of the index (i.e. down to the expenditure class) the implicit quantity weights are fixed for the life of a CPI series. When a new series is introduced (by definition, with different weights) it is linked to the previous series without affecting the index numbers in the link (or overlap) period. Linking series is discussed in more detail in Chapter 9.
- Between the expenditure class level and the elementary aggregate level, weights may be altered at any time in the life of the series. Weights may be adjusted to reflect changes in consumer behaviour in the market and hence changes in the relative importance of goods and services in the basket. Furthermore, the effects of discontinued and new products and services can also be accommodated.
- At the finest level of the index, the elementary aggregate or price sample level, there is typically no reliable information available on the market shares of individual items. In such cases, weights are not taken into account when calculating expenditure aggregates, which implicitly assumes they are equal. For example, if there was an elementary aggregate for low alcohol beer sold over the counter, then the number of major outlets (such as pubs and clubs) selected for inclusion in price samples would be roughly in proportion to their sales (if known).

Derivation of the CPI weights

5.36 The underlying quantity weights for the CPI expenditure classes are updated at approximately five yearly intervals with timing generally linked to the availability of Household Expenditure Survey (HES) data. The 14th series CPI was introduced in the September quarter 2000 using expenditure weights from the 1998–99 HES.

5.37 The weights employed below the expenditure class level are adjusted at irregular intervals according to information obtained from a variety of sources. These sources include data obtained from both within and outside the ABS (e.g. the publication *Retail World* provides information about food lines and supermarkets). Industry consultation provides a rich source of information for weight adjustment purposes. Manufacturers, importers and retailers are interviewed to obtain information about current turnover, expected future trends and new products introduced. The media also represents a major source of information for monitoring trends.

Price index formulas

5.38 The index formulas used in the CPI can be considered at two levels: the formulas applied to calculate the average price at the price sample or elementary aggregate level, and the formulas used to derive index numbers at higher levels.

5.39 As already noted, there are no explicit weights for the prices in each elementary aggregate. The primary concern, is to establish the 'best' average price for the sample. The (unweighted) geometric mean (GM) formula is the preferred formula for calculating the lowest level indexes primarily because it models, better than alternative formulas, substitutions that consumers make in their consumption of goods and services in response to changes in relative prices.

5.40 The geometric mean cannot be used to calculate the average price in all elementary aggregates. It cannot be used in cases where the price could become zero (e.g. the cost of a good or service becomes fully subsidised by the government). It is also not appropriate to use the geometric mean in elementary aggregates covering items between which consumers are unable to substitute (e.g. local government rates where it is not possible to switch from a high rate council to a low rate council without physically moving locations). For these elementary aggregates the Relative of Arithmetic Mean Prices (RAP) formula is used. For further information on these formulas, refer to paragraphs 3.37 to 3.42.

5.41 The earlier discussion of weighting implied that the reference period of the index and the weighting period of the index were the same. In practice, the ABS changes the reference period less frequently than it reweights the CPI. For example, the current reference base period for the CPI is 1989–90, while the weighting base period (the underlying quantities) is 1998–99.[58] Further, because of time lags involved in collecting the data required for reweighting, the weights are introduced with a lag. For example, the 1998–99 expenditure weights were introduced in respect of the June quarter 2000.

5.42 The practical use of index formulas in the compilation and aggregation of the CPI is discussed further in Chapter 9.

[58] Some components have a reference base later than 1989–90, reflecting their introduction to the CPI since the 11th series CPI.

CHAPTER 6 ESTIMATING WEIGHTS

INTRODUCTION

6.1 In previous Chapters it has been noted that weighting practices vary at different levels of the CPI. At published levels, weights are reviewed about every five years. Typically these reviews follow the release of data from the Household Expenditure Survey (HES).[59] At the unpublished levels the weights can be varied at any time. At the elementary aggregate or price sample level there is no explicit use of weights.

6.2 This Chapter describes the procedures that are typically followed in updating the CPI weights.

FIXED LEVEL WEIGHTS

6.3 At the fixed level of the index the ideal is to have a snapshot of all household expenditure. It is important that the data is consistent (expenditures can be added up without worries about coverage, double counting etc.) across the population group and that it relates to the same time period. For example, if expenditures were from different time periods for different items, then these could be affected by changes in economic conditions, tax rates and population growth, which could distort the weights. Also, while an information source might provide an estimate of total sales of an item, it would be necessary to know the proportion of those sales to households as consumers. For example, sales of whitegoods and browngoods will include sales that are not in scope of the CPI, i.e. to the business sector and households as owners of rental properties.

6.4 The HES is the only source of data that comes close to the ideal. However, while it provides a comprehensive coverage of household expenditures, various adjustments need to be made to the HES data for use in the CPI, and for some items it is supplemented or replaced by other data sources.

6.5 The weaknesses in the HES data for CPI purposes include:

- The HES is a survey and is thus subject to sampling error. It is possible for the selection of one or several households with exceptionally high expenditure on a certain item/s to significantly affect the expenditure estimate for that item at a regional level, especially in the smaller capital cites.
- The HES records all data as reported by households, with no adjustment for known cases of underreporting, especially in alcohol and tobacco.
- Some expenditures captured in the HES are not fully contemporaneous. Estimates for some items which are more expensive or purchased infrequently are obtained or supplemented by recall, rather than relying on expenditures actually recorded in the diary during the two week interval the household was included in the survey. Periods over which households are asked to recall expenditure varies by item — it can be the period of the last payment or up to two years in the case of house purchase and sale. There are no adjustments made to HES data for any change in prices between the period of recall and that of recording in the HES.
- There are some expenditures required by the CPI which cannot be obtained from households, such as insurance services.

[59] For information on the conduct of the HES, refer to *Household Expenditure Survey Australia User Guide 1998–99*, cat. no. 6527.0.

Determining the CPI structure

6.6 An initial starting point is to determine a CPI structure and item coverage that are consistent with the principal purpose and conceptual base and which take account of recent and expected market trends. For example, changes were made to the structure of the CPI for the 13th series to reflect the change in principal purpose to a measure of inflation. Further changes were made in the 14th series in order to better accommodate possible changes in expenditure patterns as a consequence of The New Tax System. For example, in the 13th series CPI, photographic equipment was included with Audio, visual and computing equipment in order to better allow for the growing use of digital photography (it is both complementary and competitive with other visual equipment). In the 14th series, the repair of appliances was included with purchase to reflect the substitution being made between repairing and purchasing new appliances.

6.7 As previously noted, a prime consideration in deriving the CPI structure is assessing the utility that households derive from commodities and the extent of substitution between commodities. Another consideration is the relative importance of those commodities in household expenditure and a trade-off with the reliability of estimates of those expenditures. For example it would make little sense to have an expenditure class for large durable recreation vehicles (say speed boats, dune buggies) as such purchases identified in the HES will be small in number (less so in value) and volatile over time.

6.8 The commodity classification used in the CPI is based on the international standard classification of Consumption of Individual Commodities by Purpose (COICOP). This classification is based on the concept of household utility. A significant advantage of adopting a COICOP-based classification is to align the CPI more closely with the dissection of household final consumption expenditure in the Australian national accounts (also based on COICOP).

HEC/CPI concordance

6.9 Expenditures recorded in the HES were coded according to the Household Expenditure Classification (HEC). In order to derive expenditures for the CPI expenditure classes a concordance was established with the HEC codes at their most detailed level (10 digit code). Establishing the concordance involved examining detailed listings of commodities coded to each HEC code. The concordance is available as an Excel spreadsheet in *Consumer Price Index: Concordance with Household Expenditure Classification, Australia* (cat. no. 6446.0.55.001 available on the ABS website).

6.10 A majority of HEC codes could be exclusively allotted to a CPI expenditure class. For example all of HEC 0302019902, 'Smallgoods' was allotted to the CPI expenditure class Other fresh and processed meat. However there are numerous HEC codes where a one-to-one correspondence could not be established (there are just over 600 HECs at the 10 digit level and only 89 CPI expenditure classes). The reasons as to why unique concordances could not be established include:

- The HEC code may not be sufficiently detailed. For example HEC 0302019901, 'Mince' could be prepared from a variety of meats. For CPI purposes it was decided that mince is not processed meat and hence expenditure on mince was spread across appropriate CPI meat expenditure classes.

- Information provided by households does not allow a commodity to be clearly identified. These expenditures are reported in codes such as 0302000000, 'Meat (excluding fish and seafood) nfd' (where n.f.d. is an abbreviation for 'not further defined'). Again these expenditures were spread across appropriate CPI expenditure classes.
- Households cannot or do not separately identify some expenditures. For example, in some states, state governments operate compulsory third party vehicle insurance schemes, and the amount of insurance paid is included with the vehicle registration charge, often resulting in households reporting the combined amount only. In this case a split was derived from average registration and insurance charges collected for the CPI.

6.11 Where HECs were split across expenditure classes, the splits were determined pro rata, using any industry or other data sources available or subjectively. In most cases the expenditures involved were relatively small.

Adjustments for under reporting

6.12 There are non-HES data sources that provide accurate estimates of household expenditure on some commodities (often only at the national level). These alternative estimates are used for validating the HES data and, for most products included in the CPI, were in accordance with HES estimates. However, there were significant differences between HES and other data sources in the estimates for alcohol and tobacco expenditure. For both these product groups the major consumer is households and the imposition of excise and other taxes on these products means that non-HES estimates are more accurate than the understated estimates available from the HES due, mainly, to regulatory reporting requirements.

6.13 For alcohol and tobacco, under-reporting factors were derived at the national level using household final consumption expenditure estimates from the national accounts. These factors were then applied to the HES expenditure estimates for each capital city. The 1998–99 HES has tobacco expenditure at around two-thirds and alcohol expenditure at a little over half of the respective national accounts estimates. The same adjustment factor was applied across all alcohol expenditure classes.

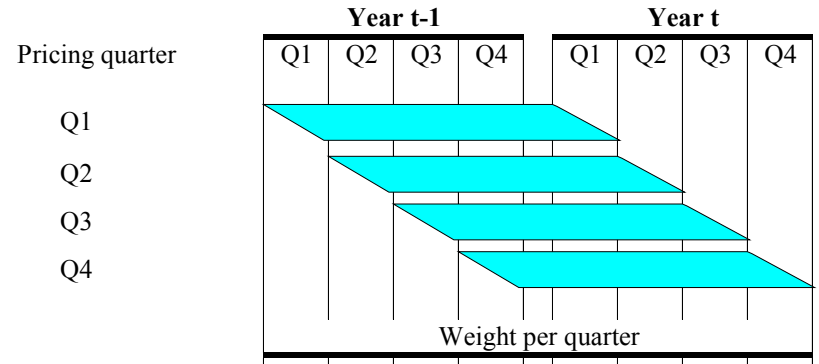
6.14 The intention of the CPI classification is that all alcohol expenditure be in the alcohol subgroup. As noted earlier, households do not always separately identify expenditures as fully as ideally required. In the case of restaurant meals, expenditure on alcohol is not always reported separately to the meal component and is sometimes reported simply as 'drinks'. A sample of household records was examined and, by applying various assumptions, an estimate was made of the proportion of reported restaurant meal expenditure that was alcohol and this factor was applied across each capital city.

Recall adjustment

6.15 As noted above, some expenditures were collected for HES on the basis of recall rather than as entries in the diary over the two weeks for which the household was in the survey. The extent of the recall period varies: for some items it is purchases in the last three months (most white goods and furniture, house repairs); last payment (general rates, electricity, health services); last 12 months (most vehicle related expenditures, education, overseas travel, house alterations and additions), and the last two years (house purchase). To the extent that prices for these items change between the time the household last purchased or paid for the item and their inclusion in the HES, expenditures will not reflect the underlying quantities acquired during 1998–99 completely accurately.

6.16 No adjustments are made for any items where the recall period is the last three months since any adjustments to be made would be relatively minor. Most items where the recall period is the last payment are typically items where the billing cycle is quarterly or less or where there are options to pay periodically (e.g. local government rates). This leaves only a small number of items such as vehicle purchase, general insurances, overseas holiday travel and education where expenditures could have been incurred up to 12 months prior to inclusion in the HES.

6.17 The adjustment procedure for a recall period of 12 months is as follows. In the first quarter (Q1) of the HES reference year the period potentially covered will be from the start of the corresponding quarter of the previous year (for those households selected in the first week of the HES reference year) through to the end of the first quarter of the reference year. Similarly, the pricing period for the households first included in the last week of Q1 in the reference year will commence in the last week of Q1 of the previous year. If expenditures are distributed uniformly over the period, then effectively expenditures in the reference quarter and the corresponding quarter of the previous year will only be half that for the intervening quarters. Thus assigning weights of say one for the intervening quarters and 0.5 for the start and end quarters, we can dervive a weighting pattern as shown below.



Pricing quarter	Year t-1 Q1	Year t-1 Q2	Year t-1 Q3	Year t-1 Q4	Year t Q1	Year t Q2	Year t Q3	Year t Q4	
Weight per quarter									
Q1	0.5	1	1	1	0.5				
Q2		0.5	1	1	1	0.5			
Q3			0.5	1	1	1	0.5		
Q4				0.5	1	1	1	0.5	
Total	0.5	1.5	2.5	3.5	3.5	2.5	1.5	0.5	16
Weight	0.03	0.09	0.16	0.22	0.22	0.16	0.09	0.03	1.00

6.18 Thus the adjustment factor for items with a 12 month recall for the 1998–99 HES is:

$$\frac{\left(I_{S98}+I_{D98}+I_{M99}+I_{J99}\right)\times.25}{\left(.03I_{S97}+.09I_{D97}+.16I_{M98}+.22I_{J98}+.22I_{S98}+.16I_{D98}+.09I_{M99}+.03I_{J99}\right)}$$

where I_{S98} is the CPI index number for the expenditure class for the September quarter 1998 etc.

6.19 With a generally low rate of price change over 1997–98 and 1998–99, the adjustments made for recall were small, although quite significant adjustments have been made in the past (e.g. for the 1984–85 HES).

Aberrant expenditures

6.20 Expenditure estimates for the CPI weights can be validated in time and spatial dimensions. Validation over time requires expenditure to be on a common pricing base (e.g. revaluing 1993–94 HES expenditures to 1998–99 prices and comparing with the 1998–99 HES results will show changes in volume terms). Any large differences can thus be investigated to see if they are valid. For example there was a large rise in expenditures on motor vehicles (both in nominal and constant prices) between the 1993–94 and 1998–99 HESs but this is broadly consistent with new vehicle sales.

6.21 The spatial dimension involves comparing expenditures across the capital cities. Estimates for the smaller capitals are obviously subject to larger sampling errors and thus expenditure estimates for some items of expenditure can be affected by what might be considered atypical expenditure patterns of a small number of households. Large differences in expenditures in terms of average weekly expenditure per household or proportions of total expenditure were identified. They were subject to further investigation and adjustments were made if the differences could not be attributed to factors such as climate or location. A small number of such adjustments were made in the smaller capital cities.

Expenditures not sourced from HES

6.22 For the 14th series CPI it was not possible to obtain suitable data from the HES for two items, namely new house purchase and general insurance services.

6.23 The concept for house purchase is that it encompasses the net expenditure on houses[60] required to accommodate the growth in the CPI population group as well as any net expansion in the volume of housing through alterations and additions. Further, the number of houses required only relates to owner-occupied dwellings and the valuation excludes the land component. The restriction to owner-occupied dwellings reflects the CPI being confined to expenditure on consumer goods and services (renting households have their expenditures on rent included in the CPI while owner occupiers do not have any rents imputed in the CPI).

6.24 The HES data on alterations and additions was used for that component, but the HES data was not considered adequate for net purchases of dwellings. Even with a two-year recall period the number of house transactions recorded was too small to produce reliable results for each individual capital city. In addition, the values reported in HES included the land component. An alternative approach of separately estimating the number of house purchases and applying an average house value excluding land had to be adopted.

[60] The term 'house' is used in a generic sense to include all forms of structured dwellings (i.e. town houses, units etc. as well as detached dwellings).

6.25 Estimates of the net change in the number of owner-occupier households can be derived from the Census of Population and Housing, the HES and the Survey of Housing Occupancy and Costs. After some investigation, the preferred estimates for each capital city were obtained by taking the average of the increase in the number of households between 1996 and 1999 calculated by applying the projected growth rate of households from *Household and Family Projections Australia* (cat. no. 3236.0) to the 1996 census estimates of the number of owner-occupier households. Estimates of the average value of private dwelling completions by capital city for 1998–99 were obtained from *Building Activity, Australia* (cat. no. 8752.0).

6.26 In Chapter 7 the measurement of general insurance for the CPI is presented in detail. Briefly, the measurement and weight for general insurance reflect the service provided by insurers rather than the gross premium. The expenditures on products funded by insurance claims are included within the expenditures for those products in the relevant area of the CPI. The value of the service of general insurance cannot be collected in the HES. Rather, estimates of the proportion of gross premiums that represents the insurance service are derived from information collected by the Australian Prudential Regulation Authority (APRA) and insurance companies. These are applied to the HES estimates of expenditure on gross premiums for general insurance. In the case of motor vehicle write-offs and vehicle smash repairs the HES estimates exclude expenditure funded from insurance claims. Again the data from APRA and insurance companies provides an estimate of claims payments relative to premiums that is added to those items.

6.27 The treatment for medical insurance, on the other hand, does involve the gross premiums. Because of the way medical claims are handled, all claim payments are used to pay for medical services (including hospital services). With no leakage of funds through the claims system, premiums are a suitable measurement of payments for medical services (plus the insurance service) and no redistribution of expenditure to the expenditures on individual medical services is required.

6.28 Another area where the HES expenditures are not consistent with the conceptual basis for the CPI is in regard to expenditure on university education. Under an acquisitions approach such expenditures should reflect paying the full fee upfront (the full amount if expenditure is deferred under the Higher Education Contributions Scheme (HECS) or the discounted fee if payment is made immediately). The HES records payments made in full plus any HECS repayments made through the tax system. HECS repayments expenditure is replaced by an estimate of the full fee for deferred payments based on various data sources including the Annual Report of the Department of Education, Training and Youth Affairs.

Revaluing expenditures to the link period

6.29 The expenditure weights derived from HES are based on expenditures in 1998–99. This new expenditure pattern was not introduced into the CPI until the June quarter 2000, the link period. As the quantities underlying these expenditures had to be preserved, the expenditures were revalued to June quarter 2000 prices. This step simply involves multiplying the 1998–99 expenditures at each expenditure class by the ratio of its price index for the June quarter 2000 to the average of its quarterly indexes for 1998–99.

Adjustments for quantity shifts

6.30 Ideally the CPI weights should be as up-to-date as possible and be broadly representative of the expenditure pattern that might be expected over the life of the index series. Thus, when the June 2000 quarter link was being introduced, it was necessary to consider whether any developments and policy changes since 1998–99 might significantly affect the expenditure pattern and whether any revalued expenditures needed to be adjusted.

6.31 A major policy change over this period was the introduction of Lifetime Health Cover. This policy contributed to a substantial increase in the proportion of the population covered by private health insurance. An adjustment was made to allow for the rise in private health insurance based on the information available at the time.[61]

6.32 Other items where expenditures were likely to have changed between 1998–99 and June 2000 were also investigated. These included the purchase of computers, Internet usage and road tolls. Some adjustments were made, although the effect on the weights at the expenditure class level was minimal.

6.33 In principle, adjustments for any significant change in expenditures between the HES collection time and inclusion of the weights into the CPI is appropriate. However, this raises a methodological issue. The adjustments to expenditures are generally made without compensating adjustments to other expenditures in the CPI basket. In other words it is implicitly assumed that increased expenditure on health insurance, for example, comes from savings and not from reductions in expenditure on other items.

LOWER LEVEL WEIGHTS

6.34 The weights and structure of the CPI below the expenditure class level are continuously subject to review and may be varied at any time. These changes are made through a process termed 'sample review'. Essentially a sample review involves selecting a component of the CPI (it could be one or more expenditure classes, or part of an expenditure class) and subjecting it to detailed examination. The review determines what changes should be made to the items priced, the outlets they are sourced from and the weights to be applied to the commodities and outlets. For example it might be determined from recent data that it is appropriate to introduce a price sample under the Fats and oils expenditure class for products composed of both butter and margarine or to change the relative importance of large retail outlets and convenience stores in the price samples for soft drinks.

6.35 Sample reviews are undertaken on a scheduled basis or in response to market changes identified. In general, the aim is to review all components of the CPI over the life of a CPI series (i.e. roughly once every five years).

6.36 Information from any reliable source is used to assess the relative importance of commodities. Sources include data collections of the ABS and other organisations, and publications by industry organisations. Information from the HES is also considered, but for the main part, is not sufficiently detailed or reliable at the lower levels of the CPI structure. For example, the HES data for types of appliance purchased would not be as reliable as industry sales data due to the relatively small samples in the HES.

[61] An adjustment was made for the quantity change only as the price index for private health insurance already captured the impact on premiums of the Federal Government rebate.

6.37 At the price sample or elementary aggregate level there are no explicit weights. Rather the price samples are constructed so as to be self-weighting. For example if there were a price sample for medium (100 g) chocolate bars and the major grocery outlets had 80 per cent of such sales and vending machines 20 per cent, then the price sample would be selected so that for every price from a vending machine there were 4 prices from the major grocery outlets.

CHAPTER 7 AREAS FOR SPECIAL CONSIDERATION

INTRODUCTION

7.1 There are a number of general issues that can present particular conceptual and measurement problems in a CPI. The purpose of this Chapter is to explain the nature of these problem areas and to outline the ways in which they are handled in the Australian CPI.

7.2 The topics included in this Chapter are:

- taxes, levies, concessions and subsidies
- seasonal goods
- second-hand goods
- services
- quality
- insurance services.

TAXES, LEVIES, CONCESSIONS AND SUBSIDIES

7.3 This section discusses the treatment of a number of government taxation, welfare and related policy measures (and some private sector actions) that affect the prices paid by households for their consumption purchases. The types of measures covered include taxes, levies, fees and charges, subsidies and concessions (referred to as 'taxes and concessions' from now on). The impact of government policy decisions on the CPI will depend on which of these measures is included and how each is measured in the CPI. Decisions on what measures are included depends on conceptual as well as practical issues.

7.4 An initial issue for determining if taxes and concessions are within scope of the CPI is the principal purpose of the index. In Chapter 4 it was noted that the domain of a CPI would vary according to the principal purpose and by implication so would the treatment of government taxes etc. It was argued that an index designed to measure changes in living standards should price items at their economic cost so that government subsidies would be excluded. It was also indicated that, in an index measuring price inflation, items with non-market prices (such as those items that are heavily subsidised) would be excluded from the domain. In practice, such items have not been excluded from the Australian CPI, as this would raise issues of public credibility of the index.

7.5 Accepting that the principal purpose of the CPI is to measure price inflation, any government charge or payment which is to be reflected in prices must be tied to the purchase of a specific consumer good or service (or the right to acquire some good or service). This criterion can be further tightened in the case of subsidies, to restrict them to those that are made directly by the government to the supplier of the good or service. If the subsidy or tax is not specific to a good or service then it can be regarded as an income transfer and the transfer may not necessarily be related to any purchase in the current period.

Income taxes excluded

7.6 Income taxes are excluded from the CPI as the amount of tax paid bears no relationship to the household's purchase of, or access to, any good or service (or a basket of goods and services). Similarly the Medicare levy and any income tax rebates or deductions are not included. An exception is the health insurance rebate. Households have the option of allowing the health fund to claim the rebate from the government at the time of paying the premium or paying the full premium and claiming the rebate when they lodge their tax return. Since the rebate is specific to health insurance, it is deducted from fund premiums in the CPI. Under the acquisitions approach,

the timing of the receipt of the rebate is irrelevant. It is the timing of the acquisition of the right to a rebate that is relevant. In the case of health insurance, this right is obtained at the time of paying the premium.

7.7 It might be argued that a small number of eligible income tax deductions should be taken into account.[62] These include deductions for medical expenses when the net payment by households exceeds a dollar amount (set out in tax legislation) in the tax year. However, such deductions are small in terms of total household expenditure and the practical difficulties of estimating the effects of such deductions on the relevant medical prices are large. Therefore, this item and some similar deductions are ignored.

Fees and charges included

7.8 On the other hand, various government fees and charges are included in the CPI because they are payments for a good or service or an inescapable cost arising from the purchase of a particular good or service. For example, a driver's licence is a payment for the right to drive a vehicle on public roads. Similarly, vehicle registration is an inescapable cost of operating a motor vehicle and confers a legal right to use the vehicle on public roads. Local government rates and charges are viewed as an inescapable cost of home ownership. Water and sewerage charges are included as they represent payments for particular goods and services.

Subsidies

7.9 Various subsidies are tied to the purchase of specific goods and thus the price measure used in the CPI is the subsidised price. Examples of this are the Pharmaceutical Benefits Scheme, Medicare bulk billing and public housing rents. In these examples the household is only charged the subsidised price. In the case of the PBS and bulk billing, the government pays the subsidy directly to the drug companies or medical professionals. Further information on the pricing of these items is in Chapter 8.

7.10 For some items it is less clear whether the subsidised price or the gross price should be used. Child-care subsidies and private rent subsidies are two such cases.

7.11 In the case of child care, and depending on the family's circumstances, the subsidy is paid directly to the child-care centre. Since the subsidy is specific to child-care services, it is subtracted from the gross price to derive a net price measure for child care.

7.12 Private rent assistance is available to various welfare recipient households who rent in the private market and whose rent payments exceed prescribed levels. The subsidy is paid to the household as an income supplement and cannot be paid directly to the owner of the rented property. Therefore, it is considered to be an income transfer and not a price subsidy.

Concession prices

7.13 For various commodities, concession prices are available to certain population subgroups.[63] These concessions are reflected in the actual prices paid by those population subgroups and should be taken into account in the CPI. Concessions can be provided by both the private and public sectors. Publicly funded concessions apply, for example, to phone line rentals by

[62] The items for which tax deductions are allowable has been reduced over the years. For example, deductions were once available for expenditures on local government rates, water and sewerage.

[63] The expansion of the population group from wage and salary earners to all private households with the introduction of the 13th series CPI meant that a wider range of such concessions needs to be included.

welfare recipients and self-funded retirees, public transport for school children and seniors, and local government rates for welfare recipients. Private sector concessions apply, for example, on admissions to movie theatres and other entertainment venues, transport and on a range of goods and services purchased by seniors' card holders.

7.14 It is not practical or necessary to take all these concessions into account. Rather, the efforts of the CPI are directed at those concessions that are significant in terms of household expenditure and for those items actually priced in the CPI. For example, to the extent that any concession is expressed as a proportion of the 'normal' price and the proportion remains fixed over time, then the exclusion of the concession price will have no effect on the CPI outcome (until the proportion changes).

7.15 Some concessions, such as the Winter Energy Concession for eligible Victorian consumers, apply only at particular times of the year. In those cases the price included in the CPI falls during the relevant period and then rises again when the concession no longer applies. Other cases, however, are a fixed discount from an annual purchase. For example, with the now discontinued Victorian Winter Power Bonus consumers were given a discount of up to $60 off their September bill. If the September account was less than $60 then subsequent accounts were debited until the total reached $60. In these cases the concession is spread across the full year in which it applies.

Taxes on business

7.16 A range of taxes applies on goods and services at various stages in the production and distribution chain before the point of purchase by households. These include customs and excise duty, wine equalisation tax and GST. Similarly, various taxes and charges are part of the costs of producers, distributors and retailers. These include pay-roll tax, company tax, and local government rates and charges. These taxes and charges all affect the final price paid by households and so affect the prices recorded in the CPI. There may be various lags before any change in these impositions is reflected in retail prices.

Weights and prices

7.17 The weights in the CPI should be calculated on a basis that is consistent with the treatment of taxes on the items being priced. Thus if an item is priced at a subsidised price, it is important that the weight assigned to that item reflects expenditures valued at the subsidised price.

SEASONAL GOODS

7.18 For many items of household consumption expenditure, purchases by consumers are spread reasonably evenly over the whole year. Their inclusion in a CPI basket is a relatively straightforward exercise, as they retain approximately the same relative share of household consumer expenditure over the year, and are available for obtaining price observations at any time.

7.19 The consumption of some goods and services is subject to seasonal influences. Consumption of these items may be negligible or zero at certain times of the year. Examples include varieties of fresh fruit and vegetables (e.g. peaches in winter months), seasonal clothing (e.g. summer and winter clothing), and ski lift tickets.

7.20 Seasonality in consumption and prices could lead to undesirable levels of volatility in the overall index. When availability of a seasonal item is low, its price may be high (if demand exceeds supply), or alternatively it could be zero (if there is no demand or the item is unavailable). Either situation will result in large price movements in response to seasonal changes. Appropriate weighting and pricing procedures can reduce such volatility.

7.21 In the Australian CPI, the use of a full-year weighting period is seen as substantially addressing the weighting issue. It ensures that expenditure on all seasonal items is included in the weights, maintaining the representativeness of the index. Alternative options are to either exclude seasonal items (thereby reducing representativeness), or to use more complicated methods such as seasonally adjusting prices, or changing weights. These alternatives are, however, likely to lead to bias in the index.

7.22 Determining out-of-season prices for seasonal items is addressed by using 'imputation', which is the construction of a price where an actual price observation does not exist. Two forms of imputation are commonly used in the Australian CPI.

7.23 One method of imputation is to hold the price constant at the level recorded when the item was last priced. This approach is most appropriate and used when items are unique (e.g. entry to sporting events such as football) and the movement in prices cannot be expected to be similar to that for other goods or services. This method is also used when prices, such as education fees, are only set annually. While these goods and services may not be seasonal in availability, the price setting procedures result in a seasonal impact on the index.

7.24 The second method of imputation is to use the price movements of similar or substitute items when the seasonal item is not available. This approach is most appropriate where the items are readily substitutable, for example fresh fruit and vegetables, and clothing. This is the normal and preferred method of imputation used within the CPI. Refer to the section on Temporarily missing price observations in Chapter 3.

SECOND-HAND GOODS

7.25 Second-hand goods require special treatment in a CPI. While net purchases of second-hand goods by the reference population should be included in the basket just like any other good, any net sales of goods by the reference population should be treated as negative expenditures and deducted from the expenditure weights. This complicates the derivation of weights and prices.

7.26 Various situations arise requiring different approaches:

- where purchases and sales of second-hand goods are directly between reference population members (i.e. no second-hand dealers involved) then such transactions cancel
- where purchases and sales are between reference population members but transacted through a dealer, then the weights should include the dealer margin (preferably shown as expenditure for the service provided by the dealer) and the price measure should be the dealer margin
- where purchases of second-hand goods are from outside the reference population group (e.g. former business vehicles, former government-owned vehicles, imported second-hand vehicles), then expenditure on such purchases should be included in the weights and priced accordingly
- where sales are by reference population members to non-reference populations, then such sales should show as negative expenditure and should be priced.

7.27 In practice it is not easy to identify all these flows. For example a reference population member might not know if the vehicle they purchased from a used car yard was previously owned by a non-reference population member (such as a business or government) or another reference population member. Therefore, simplifying assumptions are often made based on assessments of the likely significance of such flows and the ability to appropriately price such transactions.

7.28 As the 14th series CPI reference population includes all households (in the capital cities), the problem of second-hand goods is somewhat limited. If the reference population were confined to a narrow subset of households, then transfers of goods between the household types may need to be taken into account. The two commodities where transactions in second-hand goods between the reference population and other sectors are most significant are motor vehicles and house purchase.

7.29 In the case of motor vehicles, there is a substantial volume of transactions between households involving second-hand dealers and some purchases by the reference population of former government-owned vehicles. The expenditure weight for motor vehicles includes net purchases by the reference population while the price measure relates to new vehicles only. It is implicitly assumed that second-hand car dealer margins and second-hand car prices (in the case of cars purchased from other sectors) exhibit the same movements as new vehicle prices. For further discussion of motor vehicle pricing refer to the appropriate section of Chapter 8.

7.30 For house purchase, most transactions in established housing will be within the reference population, and hence the transactions will net to zero. However, there is a significant level of transactions between members of the reference population and other sectors. In particular, they include transactions involving the purchase of private rental dwellings and, to a lesser extent, purchase by members of the reference population of properties from the public sector. The approach used by the ABS to estimate net acquisitions of dwellings by the reference population effectively nets out such transfers. However, the Australian CPI does not include any dealer margin on transfers of properties between the reference and non-reference populations. Further discussion is in the appropriate section of Chapter 8.

SERVICES

7.31 In principal, the treatment of services in a CPI is identical to that of goods. However, services pose pricing difficulties because often there is no clearly defined quantity for services like there is for goods.

7.32 All goods come in discrete quantities such as units, kilos, or litres. As such they are readily quantifiable and have an associated per unit price. Services on the other hand have no discrete physical quantity. They are usually specified in terms of outcomes and, ideally, price measures should be related to those outcomes. For example, consider the case of house cleaning services. One approach is simply to price such services for a set time period, say 2 hours of cleaning per week. Another, and the preferred, approach is to price a specified set of cleaning activities (e.g. cleaning a bathroom, vacuuming carpets) of specific homes. The latter approach has the advantage in that if there are any technological changes (better cleaning materials or methods) that might reduce the time or cost of cleaning then these would be reflected in a reduction in the price. Were a set amount of cleaning time specified, then any reductions in cleaning time to achieve the same outcome would not be reflected in the price except through an explicit adjustment in the cleaning time (e.g. from 2 hours to 1 hour and 55 minutes). Most services included in the Australian CPI are priced on an outcomes basis.

7.33 A problem with some services is that they are not charged separately. For example, the price of a new tyre for a car typically includes the cost of fitting, while a restaurant meal includes both food and table service. For these items it is not necessary for the good and service to be separated, as both are jointly consumed. However, for some items such as insurance services, it is important that the service component be separately identified and priced in a CPI measuring price inflation. This is discussed further in the section on insurance services later in this Chapter.

7.34 Some services are not priced as a unit for some overall outcome but are priced individually for each sub-service component of the required outcome. Medical services represent a good example of this class of service. Take a surgical operation, for instance. Separate invoices will be received from each provider of an input service as part of an operation (i.e. surgeon's fee, anaesthetist's fee, hospital theatre charges and hospital accommodation charges). Pricing such outcomes requires that prices for each sub-service must be collected.

QUALITY

7.35 The objective of the CPI is to measure pure price change over time so identical goods and services should be priced from one period to the next. This practice is called pricing to constant quality. In reality, over time new products appear in the market and replace older products with the new products possessing different attributes (or quality). For price index purposes it is necessary to measure these changes in quality and to remove any change in price attributable purely to the change in quality from the inflationary movement in the price.

7.36 The concept of quality used in the Australian CPI is based on the notion of consumer utility. Quality change is measured by reference to the expected value to the consumer of the changes. While it is not always possible to achieve this in practice, it is the principal guideline in making decisions concerning quality change.

7.37 The term 'quality' embraces all those characteristics in a good or a service that a household values or from which it derives utility. Thus the problem is to identify those characteristics that households value, to make an estimate of the value of those characteristics and to measure the change in those characteristics embodied in the good or service so that its effect can be removed when calculating price movements. When used in this context, 'quality' encompasses all attributes of a product, including quantity.

7.38 In some cases the adjustment for quality change is relatively simple. A common case, as demonstrated in the following example, is when only the volume or weight of an item changes.[64]

7.39 Suppose there is a price sample for medium sized tins of tomato soup from three respondents, comprising the most popular selling brand each respondent sells. Now suppose in the current period the size of the can of soup sold by respondent A drops from 440 g to 400 g with no change in the sizes of the cans sold by the other respondents. The price data and index calculations for this elementary aggregate are shown in table 7.1.

[64] This approach to quality adjustment in retail prices appears to have been first formalised by Hofsten (1952).

TABLE 7.1: PRICE ADJUSTMENT FOR CHANGE IN QUANTITY

Respondent	Base Period	Previous period	Current period
	Prices		
	with no quality adjustment		
A	1.50	1.75	1.70
B	1.75	2.00	2.05
C	1.25	1.30	1.40
Arithmetic mean	1.50	1.68	1.72
	after quality adjustment		
A	1.3636	1.5909	1.70
B	1.75	2.00	2.05
C	1.25	1.30	1.40
Arithmetic mean	1.45	1.63	1.72
	Geometric mean formula		
	Price relatives		
	with no quality adjustment		
A	1.000	1.167	1.133
B	1.000	1.143	1.171
C	1.000	1.040	1.120
Geometric mean	1.000	1.115	1.141
	after quality adjustment		
A	1.000	1.167	1.247
B	1.000	1.143	1.171
C	1.000	1.040	1.120
Geometric mean	1.000	1.115	1.178
	Index		
	with no quality adjustment		
	100.0	111.5	114.1
	after quality adjustment		
	100.0	111.5	117.8
	RAP formula		
	Period to period price movement		
	With no quality adjustment		
		12.0 %	2.4 %
	after quality adjustment		
		12.0 %	5.5 %
	Index		
	With no quality adjustment		
	100.0	112.0	114.7
	after quality adjustment		
	100.0	112.0	118.3

7.40 If no allowance was made for the smaller can size in the current period, the price of the can from respondent A would show a fall of 2.9 per cent ((1.70-1.75)/1.75x100). What is required for the base and previous periods are the prices that would have been paid in those periods for the identical item that was priced in the current period. These are estimated by multiplying the base and previous period prices by the ratio of the current period quality (can size of 400 g) to the previous period quality (can size of 440 g). The ultimate result is that the geometric mean of the price relatives is 1.178 in the current period once allowance is made for the quality change, and not 1.141

7.41 Similar adjustment procedures can be adopted for other quality changes, the only issue being how to determine a suitable quality measure. For example, changes in the alcohol content of spirits could be allowed for simply by adjusting the price proportionally for the change in the alcohol content. More problematic would be the handling of changes in the meat content of sausages or the salt content of margarine.

7.42 Of course there are limits to the application of this approach. For example it would be inappropriate to replace a medium sized can of tomato soup (say 500 g) with a large (say 1 kg) or small size (say 100 g) can since price typically falls per unit of weight with significant increases in the container size. Rather, different elementary aggregates should exist for any significantly different container sizes.

7.43 The situation becomes more complicated when there are technical changes to goods and with changes in services. Consider the case of an improvement in the fuel economy of a motor vehicle brought about by, say, some modification to the engine. If there were no other changes in the vehicle (its power, speed capabilities etc.), then an estimate could be made of the fuel cost savings that would accrue over the effective life of the vehicle and the vehicle's price adjusted accordingly. It is implicitly assumed that the household values the saving of $1 in fuel cost as much as they do $1 of income which is available for spending on any other item.

7.44 In some cases there may be overlapping prices for the item with the quality change and the item it replaces. For example suppose in period t there are price observations on a standard resolution TV that is included in the TV price sample, and a comparable TV with a higher screen resolution. The standard resolution TV ceases to be available in period $t+1$. Suppose the price observations are as follows

	Period t	Period $t+1$
Standard resolution TV	$400	n.a.
High resolution TV	$500	$550

7.45 A price for the standard TV in the price sample in period $t+1$ can be imputed by using the price movement of the high resolution TV, that is $440 ($400×550/500).

7.46 This approach to quality adjustment is suitable so long as the price difference between the TVs in period t is representative of the difference in utility households derive from the two TVs. This could be expected in a competitive market and where the 'better' feature has been available for some time. It would not be appropriate if the price of the item, which is phased out in period $t+1$, is not a 'normal' price (e.g. it could be a run-out special). It also may not be appropriate if the feature is new, raising the possibility that households' perception of the utility derived from the feature may not have 'settled down' or the manufacturer is trying to extract a price premium for the new feature.

7.47 If there are no overlapping prices or those prices are not 'normal' then quality adjustment becomes more problematical. It might be possible to use the last available price of the replaced item or to use estimates of differences in manufacturing costs. Again, using manufacturing costs will only be appropriate if costs broadly correlate with consumer utility.

7.48 There are other circumstances where use of price differentials as indicators of quality differentials may not be appropriate. Examples include items that are heavily subsidised or regulated, such as public education and pharmaceuticals.

7.49 For more complex quality adjustment needs, statistical techniques such as 'hedonics' may be used. The hedonic technique involves the use of a regression equation, the 'hedonic function', in which prices from an array of different varieties of a product are the dependent variables and the characteristics of that product are the independent, or explanatory, variables. The estimated parameters from the regression provide implicit prices for each of the price-determining characteristics of the good. In more simplistic terms, hedonic modelling involves dividing a good or service into its component characteristics and using these characteristics as explanatory variables for the price.[65]

7.50 While this form of modelling is appealing, it is clear that vast amounts of data and calculations are required for the application of hedonic models. Hence, the development of a hedonic model would necessitate considerable expenditure of time and resources. An additional problem is that hedonic techniques are not readily able to deal with quality changes that are not easily quantifiable, such as the handling characteristics of a car, the quality of medical care, or whether a variety of clothing is in or out of fashion.

7.51 For some types of quality change it is doubtful that any accurate measurement of the change can be calculated. For example, consider changes in passenger vehicles in areas such as road holding, passenger safety, cabin space, and type of wheels. In the case of services, how would the value of improved medical operating procedures (e.g. keyhole surgery) that involve less pain and a speedier recovery be evaluated? Has the quality of education services changed with greater use of computers? In these cases it may be necessary to make subjective adjustments or no quality adjustment at all.

7.52 One important area of quality change is that arising from government regulations. It is ABS practice that, unless such changes clearly affect the level of utility of households, then they are not treated as quality changes. An example of this practice is that any higher price of motor vehicles occasioned by mandatory pollution requirements is regarded as a price increase, not a quality improvement.

7.53 An important issue is whether an item should be regarded as a quality change to an existing item or whether it should be treated as a 'new' item. The simplest approach is to assume the item is new and to splice it into an existing price sample. However, a splice implicitly assumes that the difference in quality[66] is equivalent to the price difference. Clearly, if it is assessed that a price differential is not a reliable indicator of quality or household utility differentials then some other appropriate quality adjustment should be made.

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[65] For example, Moulton (1995) showed how a hedonic model could be used to explain the cost of shelter. He suggested 33 explanatory variables, 15 of which were related to the actual housing unit, such as age, number of bedrooms, bathrooms and other rooms, and dummy variables for type of heating/air conditioning and kitchen facilities available. Other independent variables covered characteristics of the neighbourhood in which the housing unit was located, and conditions of the rental contract (where applicable).

[66] See Hofsten (1952, pp. 49–50).

INSURANCE SERVICES (NON-LIFE)

7.54 For insurance services in a CPI designed to measure price inflation, the ideal is to measure price changes for the provision of services by the insurer. This has implications for both the weights and price measures used in the Australian CPI.

7.55 What is the value of services provided by (non-life) insurance providers? The treatment of insurance services in an acquisitions CPI is similar to that accorded to insurance in the *System of National Accounts 1993* (SNA93)[67]. Insurance may be described as a process where households can gain financial protection against often expensive but infrequent and non-predictable events. For a scheduled fee (premium or contribution) an insurer will cover part or all of the expense imposed on the household should a nominated event(s) occur to the policyholder. The alternative to buying insurance is to self-insure, the household thus incurring the full expense should the event occur. The risk for the household of not buying insurance is that the event may occur at a time when they are financially unable to endure it. By purchasing insurance, a household can pass these risks on to an insurance company.

7.56 Insurers spread the risks over the entire population of policyholders. An insurer will set (gross) premiums at a level to cover expected claims, its administrative costs and a profit. Consequently, an insurance company is able to accumulate reserves which it will invest to help meet the cost of future claims (the earnings on reserves can be regarded as additional premium contributions by policy holders). In addition, the total cost to policyholders typically includes stamp duty and, at times, other charges such as levies for fire brigade and other emergency services. In effect the value of the service provided by insurers is only the costs and profit arising from their risk pooling activities through the collection of premiums and paying claims. (The claims payments themselves are simply a return of the 'savings' of policyholders.) These components should then determine the weight for insurance services in the index, and it should also be the basis of the price measure. A price measure for this activity would be a net premium, defined as a gross premium less the provision for claims. As taxes and levies are an inescapable cost of insurance, these should also be included in the CPI. Ideally such imposts should be shown as separate expenditure items.

7.57 The 14th series CPI attempts to approach the theoretical ideal for the measurement of non-life and non-medical insurance services. However, practical difficulties have meant that gross rather than net premiums have had to be used as the price measure that is applied to the expenditure weight calculated on the basis of net premiums. Taxes and other charges tied to the premium are included in the price and weight for insurance. For weighting purposes, expenditures on items funded by insurance claims are included in the appropriate item expenditure classes. For example, the purchase of a new car funded by an insurance claim is included in the motor vehicles expenditure class. Thus these insurance services are priced on a gross basis, insurance weights are on a net basis, and the weights for goods and services are on a gross basis. Life insurance is excluded from the 14th series CPI as it largely represents a financial investment. Medical insurance has both expenditure and price measured on a gross basis. Refer to paragraph 6.27 for more detail on medical insurance pricing.

7.58 An illustrative example of the calculation of the price index for insurance services is provided below.

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[67] Refer to United Nations (1993).

7.2 CALCULATING A PRICE INDEX FOR INSURANCE

Period	Premiums before tax ($)	Tax rate (%)	Gross premiums ($)	Claims ($)	Insurance service ($)
1	100	5	105	60	45
2	100	15	115	60	55

7.59 Note that from paragraph 7.54, the ideal is to measure price changes for the provision of services by the insurer, the 'insurance service charge'. In the case of no premium supplements and no actuarial reserves, the insurance charge is obtained simply as gross premiums less claims.

7.60 Suppose that the only change between periods 1 and 2 is a change in the tax rate from 5% of premiums to 15%. Under this scenario it is clear that the insurance service charge has increased from $45 to $55 (an increase of 22.2%) whereas gross premiums have increased by only 9.5 per cent.

7.61 In an inflation index, insurance services would have a weight based on the value of the insurance charge ($45) and show a price change of 22.2 per cent. Note that in a living cost index, insurance would have a weight based on the value of gross premiums ($105) and show a price change of 9.5 per cent.

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CHAPTER 8 COLLECTION METHODOLOGY

INTRODUCTION

8.1 This Chapter describes the collection methodology used in the Australian CPI, with general collection issues discussed initially, followed by more detailed explanations of collection methods and procedures related specifically to each of the 11 CPI groups.

SAMPLING

8.2 To achieve the Australian CPI conceptual objective of measuring pure price changes over time, regular monitoring of the prices of goods and services acquired by the CPI population group will obviously be necessary. However, it is not possible in practice to price every single type or variety of good and service purchased by the CPI population group at each collection cycle. The ABS overcomes this practical problem by using purposive sampling procedures, where representative sets of goods and services are selected for regular pricing. Similarly, it is not practicable to observe the prices of the selected goods and services in all retail outlets selling these items to the CPI population group. Again, the ABS uses purposive sampling to select a representative sample of outlets at which to price the selected items in each collection cycle.

SELECTING THE GOODS AND SERVICES

8.3 The goods and services included in the CPI pricing samples are selected carefully to represent the range of types, varieties, etc. of goods and services bought by the CPI population group. Selection is made only after obtaining detailed information about the buying habits of the CPI population group, such as which varieties and brands of products are the largest selling types or which packaging sizes are most commonly used. This process involves extensive consultations with retailers, manufacturers, importers, government authorities, professional and trade associations and so on. In selecting the items to be priced, the following factors are taken into consideration:

- The relative importance of the expenditure class in relation to the total CPI; in general, the more important the expenditure class, the larger the number of items priced.
- The degree of homogeneity in the range of goods or services covered by the expenditure class; the more homogeneous the range, the fewer the number of price indicators required.
- The extent to which the various products covered by an expenditure class are subject to different influences and cost pressures, likely to result in disparate movements in prices.
- The likelihood of the particular type of good or service continuing to be available on the market for a reasonable period of time; in general, it is preferable to price the same specific items for a reasonable length of time rather than having to change price indicators regularly when particular goods or services appear and then disappear after only a short time in the market.
- The extent to which the item can be defined and described clearly and unambiguously, to ensure that the selected goods or services can be priced to constant quality over time; for example, in pricing confectionery, it is likely that packaged, brand-name chocolates would be easier to price to constant quality over time than loose chocolates with no identifying brand name.

8.4 After the items to be priced have been selected, detailed specifications are prepared to ensure that all staff involved in price collection and compiling the CPI have exactly the same understanding of which particular items are to be priced. In most cases for goods, it is a relatively straightforward matter of specifying the characteristics involved in describing the items. The characteristics may include brand name, material of composition, model number, style, size, colour and type of packaging.

8.5 As discussed in Chapter 7, it is generally more difficult to specify service items adequately because both quantity and quality are less readily describable for these items. In addition, more detailed descriptions are usually required in the specifications for services in comparison to those for goods. For example, the specification for a can of tomato soup would consist of only two characteristics: the brand name and the weight of the can. However, the specification for a travel service like a bus fare will have to include three characteristics: the age of the purchaser (as both adult and child fares will be required), the specific route priced and the time of the journey (peak or off-peak fare).

8.6 The preferred practice in pricing goods for the CPI is to price identical specifications (i.e. the same brand name, size or model of product) at all outlets in all cities. The nature of many goods and services, however, makes this impossible for a large number of cases. In practice, products are categorised into one of three categories:

(i) *National standards*. These products are available in all cities and at the vast majority of respondent outlets. They can be readily and clearly defined by characteristics such as make, model and size, as a specification for use nation-wide. Field Officers have no latitude in choosing the product for pricing. Examples include motor vehicles and major brand breakfast cereals.

(ii) *Respondent standards.* In these cases, the product can be readily defined with regard to form and function but a multitude of brands and models may exist making it virtually impossible to guarantee that any one example of the product will be available Australia-wide. A generic description is provided in sufficient detail to ensure that the field officers will be able to locate an example of the product, consistent with the quality of those chosen in other outlets within the one city and broadly consistent with those in other cities. An example of the required type of product is chosen at each respondent outlet and its defining characteristics are added to the generic description for future use at the particular respondent. Examples of such products are beer, daily newspapers and furniture.

(iii) *Volume sellers*. For some products, there are a very large number of brands or varieties available and these are fairly readily substitutable for one another. In general, consumers show no, or minimal, brand loyalty or preference and base their choice purely on price. In these cases, brand is not considered a vital characteristic and the field officers collect the price of the cheapest brand available from each respondent. Examples of these products include margarine, frozen chickens, tubs of ice-cream and the cheaper brands of spirits.

NEW GOODS AND SERVICES

8.7 From time to time, major changes in existing products and services take place or new products and services become available on the retail market and begin to account for a significant share of household expenditure. Some examples in recent years are DVDs and electronic games. In such cases, careful consideration is given to whether these new goods or services should be priced for the CPI.

8.8 If a new product or service is deemed to be a completely different category of product (i.e. a new expenditure class) from any of the goods and services already included in the CPI, its inclusion would be considered only during one of the periodic review and re-weighting exercises. The inclusion of television sets in the 1960s is a good example of such an occurrence. However, where a new product or service falls within the definition of an existing expenditure class (e.g. the introduction of colour television sets or mobile telephones), the issue is when and how to introduce the product into the process of regular measurement of price movements for the CPI. Normally, the decision is made after consideration has been given to the following factors:

- The product's share of the market: this has to be substantial before there is any point in introducing a new item.
- Whether the product is firmly established and expected to become a permanently significant item of expenditure, rather than merely enjoying high sales temporarily because of novelty value.
- Whether a *normal* price structure has been established, i.e. a price structure that is not unduly influenced by factors such as prestige, novelty value or relative scarcity of the product.

8.9 In general, a conservative approach is applied when dealing with the introduction of new products or services into the CPI. They are introduced into existing expenditure classes only after it is deemed that they have become widely available to the buying public, have become a permanent feature of household expenditure and that the price structures of these items are free from high premiums due to novelty value or scarcity of the item. All introductions of new items are handled by splicing the new item into the index so that its introduction does not, of itself, affect the level of the index.

SELECTING THE SAMPLE OF OUTLETS FOR PRICING

8.10 Consumers purchase the goods and services priced in the CPI from a wide variety of retail outlets. Examples of these outlets include department stores, hotels, motor vehicle dealers, doctors, electricity and gas authorities, travel agents, schools and child-care centres. For every item selected for pricing, the main types of outlets from which the CPI population group buys the items need to be identified so that the ABS can select representative samples of these outlets.

8.11 In selecting outlets for inclusion in samples for the CPI, the following factors are taken into account:

- The relative importance of the expenditure class in the CPI. In general, the more important the item is (i.e. the larger the expenditure weight), the larger the sample.
- The number of suppliers of the good or service in the city concerned. Generally, the larger the number of suppliers, the larger the sample. In some cases, however, there may be only one supplier, such as an electricity or transport authority.

- The degree of dispersion in prices among outlets. Where the expected dispersion of prices is large, the sample will need to be large. For example, a large sample of petrol retail outlets is usually needed because of wide variations in prices as a result of discounting practices. In the case of newspapers, a small sample is sufficient because standard prices are generally adhered to.
- The geographical spread of outlets. As far as possible, the samples are selected to cover the main areas in which households from the CPI population are known to make their purchases.
- The ownership of chains of outlets. Large retail chains frequently have a common Australia-wide or state-wide pricing policy. In these cases, pricing one outlet in the chain would be considered sufficient to obtain a representative estimate of price movement for that chain but the usual procedure is to have a number of observations in the samples commensurate with their overall market shares.

CHANGES TO OUTLET SAMPLES

8.12 The samples of respondents are reviewed regularly to ensure that they remain representative of the CPI population group's sources for purchases. Events such as company takeovers, new retailers entering the market, existing chain organisations opening new outlets or new shopping complexes opening up can all lead to the need to change the samples of respondents so that they continue to be representative of the CPI population group's overall purchases. Changes to the sample of respondents or specifications are carried out using a splicing process. A worked example of this process is presented in Chapter 3.

PRICE COLLECTION PROCEDURES

8.13 To ensure the accuracy of prices used in the CPI, the vast majority of price information is collected via personal visits to the selected respondents. These personal visit collections are made by trained and experienced ABS field staff, who observe actual marked prices as well as discuss matters such as discounts, special offers, and volume selling items on the day, and record this information in handheld computers. The regular personal visits by field staff to the retail outlets also enable the field officers to continuously monitor activity in the market (such as market shares or possible quality changes). This information is used in maintaining sample representativeness, making quality change assessments and so on.

8.14 Once items have been selected they are organised into groups (called collections). Each collection contains products that are generally sold by all possible respondents and are also usually located together within any one store. An example of a collection would be a 'white goods' collection. This would contain refrigerators, washing machines, dishwashers and clothes dryers. Most respondents that sell any of these products will sell all of the products. These products are also usually located in the same area of any store.

8.15 The main benefits gained from grouping items within these collections are:

- maintenance of representative samples is easier, as generally all possible respondents are able to supply all prices
- the effort required by field officers to maintain collection itineraries is minimised.

8.16 The grouping of items into various collections is based on the situation faced by consumers in the market place, not by any ordering required for index estimation. The collection and use of alcohol prices provides a good example of this. Alcoholic beverages of all types are sold in two ways:

- as individual drinks for consumption on the premises
- in containers for consumption off the premises of the vendor.

8.17 Once collected the prices are re-sorted into the CPI compiler's perspective i.e. categorised by alcohol type (beer, wine and spirits) for use in index estimation.

8.18 The ABS does not use list prices or recommended retail prices without checking that these are, in fact, the prices charged to customers by the respondent concerned. Special prices and discount prices are taken into consideration when these are generally available to the buying public. The basic test of whether such prices can validly be used in compiling the CPI is whether the goods are of a quality identical to that in the item specifications (e.g. the goods are not damaged or superseded stock) and are available in quantities sufficient for shoppers generally to buy them on the pricing date (i.e. there are not merely a limited number available to early bird shoppers or purchases are not subject to some other restriction).

8.19 While special and discounted retail prices are readily observable for the majority of goods, it is not necessarily the case for large and expensive durables, in particular motor cars, as prices sometimes may not be advertised widely and may be disguised in the form of bonuses (so-called trade-ins, extra features etc.). In such cases, substantial effort (including interviews with senior sales staff) is made to ensure that full particulars of the actual transaction prices are obtained.

8.20 In cases where prices are set centrally and do not vary by location, the prices are collected from the supplier's Head Office. Postage charges are a good example of this situation.

MISSING OBSERVATIONS

8.21 In some cases, it is not possible to collect the price of a certain item in a particular period. This can be due to various circumstances, with a common one being the item was out of stock in the outlet sampled. The section on temporarily missing price observations in Chapter 3 describes several ways of dealing with this situation. The procedure most commonly used in the Australian CPI is to impute a movement for the missing item based on the price movements of the other items in the sample. The implicit assumption behind this procedure is that if it had been possible to collect the price of this item, its price would have changed in line with similar items. In most cases, this is a reasonable assumption and will provide an acceptable outcome for the index.

8.22 This method would be inappropriate when a product has no close substitutes or if its price is reviewed (and collected) annually. In these cases, a more appropriate method of imputation is to repeat the previous price.

EDITING BY FIELD OFFICERS

8.23 Price editing commences during the actual collection process. The handheld computer used to collect the prices has a number of facilities designed to help the field officers edit the data as it is being collected. Examples of these edit checks include:

- immediate calculation of the percentage change in price for the item

- a facility for storing annotations about the price, such as notes from a discussion that they may have had with store staff about a change in the price
- a facility for entering an edit symbol that describes the situation; the edit symbol must be consistent with the price movement.

8.24 Further editing checks, mainly to do with overall consistency, are performed back in the office.

QUALITY ADJUSTMENT BY FIELD OFFICERS

8.25 Field officers are able to enter all the information necessary for quality adjustment to prices into the handheld computers.

8.26 If the field officers find themselves in a situation where they do not have all the necessary information for a successful quality adjustment calculation, then the record is flagged as such and dealt with by the index compilers.

CHECKING BY COMPILING STAFF

8.27 The collected prices undergo further checking by the staff responsible for compiling the index. Where prices are found to be unusual (for instance, when movements are not considered representative) or not within expectations (i.e. inconsistent with knowledge gained from other sources), they are generally referred back to the field officer for verification.

8.28 Investigations are conducted to enable quality adjustments to be performed on records flagged by field officers as having quality changes which were not readily quantifiable.

PRICING BASIS

8.29 The weighting pattern for the Australian CPI is based on the acquisitions concept and so the pricing of goods and services is also based on this conceptual approach for consistency (refer to Chapter 4 for an explanation of the different conceptual bases). In most cases, the acquisition of the good or service occurs at the same time as the payment and so any price movements are recorded then. There are some goods and services where payment for, and acquisition of, the good or service do not coincide. In these cases, prices are recorded at the time the good or service is acquired and not when the payment is made. Examples where this can happen include:

- *Goods and services invoiced periodically after consumption* (such as electricity and telecommunications, and home delivered newspapers). Price movements are introduced into the index calculation from the date at which the price change is effective. Providers are therefore approached for price information regularly to obtain current charges and dates of effect for planned price changes.
- *Goods and services paid for through loans* (for instance, motor vehicles). For index purposes, the price recorded is the full transaction price of the product at the time of acquiring the product. The method and timing of payment is irrelevant under an acquisitions approach.
- *Goods and services regularly paid for in advance* (for instance, international airfares, club membership and magazine subscriptions). For index calculation purposes the price is included when the good or service is actually acquired (i.e. date of the flight for an airline ticket or the commencement date of the subscription period) and not the date at which the payment is made. However, prices are collected at the time payment would normally be made. For example, a ticket for flights is typically paid for about a month before the departure date so the price included in the CPI for a June flight is that collected in May for travel in four weeks time.

PRICE COLLECTION FREQUENCY

8.30 As the CPI is compiled on a quarterly basis, prices of most goods and services in the regimen are collected once each quarter. Prices of goods and services that are considered to be volatile (i.e. likely to change more than once during a quarter) are collected more frequently. A small number of items are collected only once a year, either due to known price review periodicity (e.g. council rates) or seasonal availability (e.g. football matches). The general approach is to price each item as frequently as is necessary to ensure that reliable measures of quarterly price change can be calculated. Information about the frequency of collection of the various products in the index is included in the detailed descriptions for each CPI group in this Chapter.

8.31 The following sections describe in more detail the price collection methodology used in each of the 11 CPI groups. A brief description is provided of the group's index structure, products priced, the frequency of collection and the types of outlets from which the prices are collected. Collection issues specific to each group are also highlighted.

FOOD

8.32 The Food group includes all expenditure on food and beverages, other than alcoholic beverages, purchased for human consumption (pet food is included in the Recreation group). The subgroup accounted for approximately 18 per cent, by value, of the CPI basket at the time of the 14th series review. Table 8.1 shows the group's index structure, examples of the products priced and types of outlets visited.

TABLE 8.1: FOOD GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of products priced*	*Outlets/source of price collection*
FOOD		
Dairy and related products		Supermarkets,
Milk	Fresh milk (including flavoured) and substitutes (e.g. soy milk)	convenience stores
Cheese	Cheese: all types, including sliced and grated	
Ice cream and other dairy products	Yoghurts and other dairy snacks, powdered and condensed milk, milk based ice confectionery for consumption at home, cream	
Bread and cereal products		Supermarkets,
Bread	All types of bread	convenience stores,
Cakes and biscuits	Cakes, muffins, pastries and biscuits	bakeries, cake retailers
Breakfast cereals	All grain based breakfast cereals, including muesli	
Other cereal products	All types of flour, rice, pasta and similar grain based products, including bran	

Group, subgroup, expenditure class	*Examples of products priced*	*Outlets/source of price collection*
Meat and seafoods		Supermarkets,
Beef and veal	All cuts of beef and veal; fresh, chilled and frozen, including mince	butchers, fish markets, delicatessens
Lamb and mutton	All cuts of lamb and mutton; fresh, chilled and frozen	
Pork	All cuts of pork; fresh, chilled and frozen	
Poultry	Pieces or whole poultry; fresh, chilled or frozen	
Bacon and ham	All styles of bacon and ham; fresh and canned	
Other fresh and processed meat	Sausages, salami and other processed meats, game meats, fresh, canned or frozen	
Fish and other seafood	All seafoods; fresh, chilled, frozen, canned or processed	
Fruit and vegetables		Supermarkets, fresh
Fruit	All fruit; fresh and chilled, canned, dried or frozen	produce markets
Vegetables	All vegetables; fresh and chilled, canned, frozen, dried or pickled	
Non-alcoholic drinks and snack food		Supermarkets, convenience stores,
Soft drinks, waters and juices	All carbonated and still non-alcoholic drinks and cordials, including water, fruit and vegetable juices and drinks	take away outlets
Snacks and confectionery	Lollies, chocolates, nuts, corn and potato chips, gum and similar items, and water based ice confectionery	
Meals out and take away foods		
Restaurant meals	All meals eaten in restaurants, hotels, cafes etc.) offering full table service	Restaurants, cafes, clubs
Take away and fast foods	All take away and delivered meals	Fast food outlets (including those with tables)

Group, subgroup, expenditure class	*Examples of products priced*	*Outlets/source of price collection*
Other food		Supermarkets
Eggs	Fresh (avian) eggs	
Jams, honey and sandwich spreads	Jams, syrups, cheese and yeast based spreads and dips	
Tea, coffee and food drinks	Tea (leaves, bags etc.) and coffee (instant, ground etc.), chocolate based food drinks	
Food additives and condiments	Sugar and artificial sweeteners, salt, spices, sauces and pastes and salad dressings	
Fats and oils	All butter, margarine and cooking oils	
Food n.e.c.	Foods not classified above, including canned and packet soups, baby foods, prepared meals (fresh and frozen requiring cooking/heating)	

Specific issues

Price collection

8.33 In general, prices for processed foods are collected quarterly while prices for fresh foods are collected monthly as they tend to fluctuate more.

Areas requiring special pricing procedures

Bread

8.34 The prices of packaged loaves of bread tend to fluctuate a lot. Consequently this product is priced monthly while loaves of fresh baked bread are priced quarterly. Products such as bread rolls are sold by piece rather than by weight and are excluded since it is generally not possible to ensure that they are priced to a constant quality. Price movements for similar products are used to represent price movements for these products. For example, in the case of bread rolls, price movements are represented by the movements in prices for loaves of bread.

Fresh fruit and vegetables

8.35 Fresh fruit and vegetables are usually priced on a 'volume seller' basis, whereby the variety of a particular fruit or vegetable in greatest demand is priced. When fruit and vegetables are not available due to being out of season, prices are imputed based on price movements of substitute produce that is available.

Meals out and take away food

8.36 Restaurant meals are priced at a variety of restaurant types (categorised with regard to level of service and of food styles). Entrees, main meals and desserts are priced separately, and to ensure adequate coverage, main meals based on several types of meat dishes, and a variety of entrees and desserts, are priced.

8.37 In certain cases, the distinction between an eat-in restaurant meal and a takeaway meal can be blurred. For example, some take away food establishments have tables on their premises for customers to consume their food, despite their main business being a takeaway food outlet. A general rule used to distinguish between restaurant and takeaway meals is that table service will be provided in restaurant meals. In the example provided earlier, no table service is provided for the meals consumed at the tables provided by the establishment and therefore, these will be treated as takeaway meals.

Seasonality

8.38 A number of items in the Food group are subject to seasonal influences, especially fresh meat, fresh seafood and fresh fruits and vegetables. When an item is out of season and unavailable, the price of the item is normally moved forward in line with changes observed in prices of close substitute products or items in the same expenditure class. For example, the expenditure class 'Citrus fruits' consists of three different types of fruits, which are grapefruit, mandarins and oranges. If mandarins are out of season, then the price movement for 'Citrus fruits' generated by changes in orange and grapefruit prices will be used to impute the price of mandarins. Refer to Chapter 7 for a more detailed explanation of the treatment of seasonal items.

8.39 In some cases, it is not unusual for products that are out of season to be still available, although the product may be of substandard quality and in low supply. Field officers will not accept prices in these cases and will treat the product as though it were not available.

Quality adjustments

8.40 Quality adjustments are frequently required for items priced within the Food group. Food items sold in packages (e.g. breakfast cereals) often undergo changes in packaging sizes and content mixture. To ensure that such items are priced on a 'constant quality' basis, the collected prices are quality adjusted to remove the packaging size or content changes.

8.41 Products in the Food group are also subject to regular market innovations, for example, the addition of new ingredients into food products or the existing product is now marketed under a new formula. In these cases, it is sometimes difficult to decide whether to treat the change as a quality adjustment or to assume that a new product has been put on the market. Generally, the choice of treatment will depend on the results of analysis based on sales and market information and close monitoring of these modified products for an extended period.

8.42 An area of the Food group where quality is an important issue is in the pricing of fresh meat, seafood and vegetable products. Mincemeat, for example, can come in normal or premium grade and considerable care is taken by field officers to ensure that comparable grades are priced in each period. Regular assessments of the consumption of each grade type are also conducted to ascertain which grade should be priced. Prices of most meat items are taken from the price displayed in the retail outlets, which are usually quoted on a per kilo basis. However, some particular cuts of meat are sold as an item, for example, a leg of lamb. In these cases, both the actual weight of the item and the associated price are collected to enable a comparison on a per kilo basis, thus removing any price variations caused by weight differences. Similarly, some vegetable produce (e.g. cauliflower and lettuce) are also sold as a whole item and not by weight. To ensure that price comparisons of these items are on a 'constant quality' basis, a per kilo price is estimated by the field officer. Several pieces of the vegetable produce are weighed to determine an average weight and the price is divided by the average weight to derive the per kilo price.

8.43 Assessing the quality change in restaurant meals and takeaway foods can be very difficult as there is no reliable indicator of changes in the quality of the meals. Prices of meals tend to remain the same between one pricing period and another but side salads and vegetables may be adjusted to meet seasonal availability or the weight of cuts of meat in the meals may be varied because of price changes in the meat industry. Field officers will note any changes of this nature where possible and will attach comments to the prices to highlight these situations so that consistent quality adjustments can be made if considered necessary.

8.44 Another quality issue with meals and takeaway foods is the treatment of special meal deals. Although these 'meal deals' are frequently the most popular product sold, the items in the meal deal are priced separately because identifying the quality change for the meal deal as a whole can often be difficult. For example, the items within the meal deal can be varied or the meal deal cancelled entirely, and these changes would present problems in calculating price movements based on the 'constant' quality concept. Many of these meal deals are also likely to be affected by product launch promotions, and new meal deals are only included in the list of items to be priced when they have a proven sales record.

ALCOHOL AND TOBACCO

8.45 The Alcohol and tobacco group includes expenditure on all types of beverages containing alcohol, such as beer, wine and spirits and all tobacco related products such as cigarettes, cigars and loose tobacco. The Alcohol and tobacco group accounted for just over 7% of the CPI basket at the time of the 14th series review.

8.46 Table 8.2 shows the structure of the Alcohol and tobacco group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.2: ALCOHOL AND TOBACCO GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of products priced*	*Outlets/source of price collection*
ALCOHOL AND TOBACCO		
Alcoholic drinks		
Beer	Beer in cans and bottles	Bars, restaurants, clubs, bottle shops
Wine	Bottled or cask wine	Restaurants, bottle shops
Spirits	Whisky, rum, brandy	Bars, restaurants, clubs, bottle shops
Tobacco	Cigarettes, cigars, pipe tobacco	Tobacconists, supermarkets

Specific issues

Price collection

8.47 Nearly all alcoholic products, whether consumed on the premises of the retailer or consumed elsewhere are priced monthly. The only exception is alcohol purchased in restaurants because prices tend to be more stable in these establishments. Tobacco products are priced on a monthly basis. Field officers collect prices of all products in this group.

Areas requiring special pricing procedures

Alcoholic drinks

8.48 Alcoholic products are often subject to specialling activity, where large discounts are offered on a few products for a short time period only. Prices of alcoholic drinks are also affected by seasonal celebrations, for example, during the Christmas holiday period and the running of the Melbourne Cup. To ensure price fluctuations caused by specialling activity and seasonal celebrations are captured in the CPI, all alcoholic drinks, except those sold in restaurants, are priced monthly.

8.49 The alcoholic products priced are selected according to the purchasing patterns of consumers. In the case of beer, strong preferences for particular brand names tend to exist and the brands are selected according to analysis of their market shares in the retail beer industry. For sparkling wines, cask wines and some types of spirits, the consumer's choice is significantly influenced by the price of the product. Consequently, the brand names selected for pricing are determined according to a 'volume seller' basis (explained in paragraph 8.6), where the brand priced in any particular quarter is the cheapest variety available from a given list of brands. The consumption of bottled wine and a few other types of spirits tend to be affected more by locality and, therefore, are priced on a 'respondent standard' basis. Under this pricing procedure, field officers will seek advice from the respective retailers to determine which particular brands are the most representative of the purchasing pattern of customers in that geographical region and these brands are priced.

Cigarettes and tobacco

8.50 The brand names of cigarettes, cigars, and pipe tobacco selected for pricing are based on their market shares in the tobacco industry.

Excise duty on alcohol and tobacco

8.51 In accordance with the indexation provisions of the Excise Tariff Act 1921 and the Customs Tariff Act 1987, the rates of customs and excise duties on spirits, beer and tobacco products are changed twice yearly in line with movements in the Consumer Price Index. The new rates take effect from 1 February and 1 August each year. The price change due to the change in the rate of custom or excise duty is collected as part of the general price movement of alcohol and tobacco products.

Quality adjustment

Alcoholic drinks

8.52 Prices of alcoholic drinks, where necessary, are adjusted to ensure that price comparisons are on a 'constant quality' basis. Producers of alcoholic drinks will sometimes make no changes to the prices of their products but will make specification changes that will impact on the quality of these products. Examples of these changes include changing the alcoholic content of a product or modifying the packaging to change the volume content. Adjustments will be made to take into account these specification changes to ensure the concept of pricing to 'constant quality' is maintained. However, no quality adjustment is made to wine products for changes in the alcoholic content as this is a function of the fermentation process and the climate experienced during the grape growing season.

Cigarettes and tobacco

8.53 Prices of cigarette products are quality adjusted where necessary and quality is measured by the quantity of tobacco used in each cigarette. Information is obtained on a regular basis from the major cigarette manufacturers to monitor changes in the quantity of tobacco in cigarettes. If a significant change in the tobacco content of a particular brand of cigarette is identified, the price will be adjusted to remove the effect due to the quality change.

CLOTHING AND FOOTWEAR

8.54 Conceptually, this group includes expenditure on clothing, footwear, accessories such as watches and jewellery, clothing services such as dry cleaning and shoe repair services. The Clothing and footwear group accounted for just over 5% of the CPI basket at the time of the 14th series review.

8.55 Table 8.3 shows the structure of the Clothing and footwear group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.3: CLOTHING AND FOOTWEAR GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
CLOTHING AND FOOTWEAR		
Men's clothing		
Men's outerwear	Suits, jumpers, coats, pullovers, jeans, business and casual shirts, T-shirts and shorts	Department stores, speciality menswear stores, sports stores
Men's underwear, nightwear and socks	Briefs, singlets, pyjamas and socks	Department stores, specialty men's stores

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
Women's clothing		
Women's outerwear	Dresses, blouses, suits, jeans and coats	Discount clothing stores, department stores, specialty women's stores
Women's underwear nightwear and hosiery	Bras, briefs, nightwear, hosiery and slips	Discount clothing stores, department stores, specialty women's stores
Children's and infants' clothing		
Children's and infants' clothing	Jeans/pants, shorts, T-shirts, socks, skirts, underwear, pyjamas, school clothing, pullovers	Discount clothing stores, department stores, speciality clothing stores
Footwear		
Men's footwear	Men's dress shoes, casual, sports shoes and slippers	Department stores, specialty shoe stores, sports stores
Women's footwear	Women's court shoes, dress shoes, casual shoes, sandal, sports shoes and slippers	Department stores, specialty shoe stores, sports stores
Children's footwear	School shoes, girls' dress shoes, general sports shoes and hiking boots	Department stores, specialty shoe stores, sports stores
Clothing accessories, supplies and services		
Clothing accessories and jewellery	Items complementary to clothing, including wallets, umbrellas, watches, luggage and backpacks	Department stores, specialty luggage stores, jewellery stores, duty free stores
Fabrics and knitting wool	Fabrics, wool, dress making patterns, and sewing materials	Department stores, specialty fabric stores
Clothing services and shoe repairs	Clothing and footwear services including dry cleaning, shoe repairs and Laundromat charges	Specialty shoe repair stores, laundromats, dry-cleaners

Specific issues

Price collection

Clothing

8.56 All products priced for this group are priced quarterly with the exception of seasonal clothing. Summer seasonal clothing is priced in the December quarter each year and winter seasonal clothing in June quarter. 'Clearance' prices are ignored unless the product concerned is available in sufficient quantity for all prospective customers over the full quarter.

8.57 Much of seasonal women's clothing exhibits a significant fashion content. As a result, from season to season, the individual products can show significant physical changes. Information from garment manufacturers, importers and major retailers is used to determine corresponding replacement products from the new season line-up.

Footwear

8.58 The range of footwear products priced includes business shoes, casual and fashion footwear, school shoes and sports shoes. Brand names selected for pricing are normally widely available across the retail sector and selection is based on information of the market share of the major footwear brand names. Prices are collected from specialist footwear retail outlets and from large department stores with footwear sections.

Clothing accessories, supplies and services

8.59 Clothing accessories comprise personal effects such as watches, wallets, umbrellas, suitcases and backpacks. Included in clothing supplies are fabrics and haberdashery used for clothing homecraft, repairs and alterations. Examples of items classified under clothing services are dry-cleaning and shoe repairs. Prices of items in this subgroup are collected quarterly by field officers at retail outlets such as jewellers, homecraft shops and clothing repairers.

'Special' prices

8.60 'Sale' or special prices for clothing items are acceptable for the CPI provided:

- the style name is available to be repurchased from the supplier
- a full size and colour range is available
- the 'special' requires no reciprocal commitment from the customer (e.g. to make a bulk purchase)
- the promotional price applies for the full day on which the field officer visits.

8.61 'Specials' on clothing and footwear can often be associated with the cessation of a particular style or product range. In these cases, where there is only a limited range of the product available at the sale price, the drop in price would be ignored, as it would not be representative of genuine price changes. Specialling activity is closely monitored, especially to check whether the specialling is widely available across the range of the product or limited to certain items only.

Seasonal items

8.62 A significant proportion, weighted by expenditure, of clothing items is classified as seasonal, especially for women's clothing. As a result, each quarter there are a significant number of prices that need to be imputed for out-of-season products. Prices for these out-of-season products are moved in line with changes observed in prices of available products.

Sample selection and maintenance

8.63 Clothing respondents are largely selected and weighted by a 'top down' approach. The initial phase of this process is to identify and weight market niches for the different ranges of clothes. Retail chains, store franchises and outlet members of buying group networks are then chosen to represent those niches based on their market shares. This approach results in a cost effective manner of maintaining stable outlet sample structures. Specification choices, however, are not determined by the 'top down' approach but are under continuous review, as many of these products have short life cycles.

Quality adjustment

8.64 Pricing to constant quality is managed by using information from manufacturers, importers and major retailers for making quality adjustments to prices. For clothing items where specification weights are especially high or where quality change is suspected because of aberrant price movements, sample purchases of these items are made and the fabric and construction qualities subjected to integrity tests. Outcomes from these quality assessments form the basis of subsequent price adjustments.

HOUSING

8.65 Conceptually, the Housing group includes all expenses relating to rents, utility services, purchase and maintenance of dwellings and other expenditure on shelter-related goods and services. At the time of the 14th series review, the group accounted for nearly 20 per cent of the CPI basket of goods and services.

8.66 Table 8.4 shows the structure of the Housing group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.4: HOUSING GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
HOUSING		
Rents	Rent paid to private and government landlords, including housing authorities, Defence Housing Authority	Real estate agents, state housing authorities, Dept of Defence (in Darwin)
Rents		
Utilities		
Electricity	Electricity charges and connection fees	Electricity providers in every city
Gas and other household fuels	Mains and bottled gas, and connection fees, firewood, heating oil, charcoal and coal	Gas providers, private wood suppliers, oil distilleries, fuel companies
Water and sewerage	Water supply and sewerage charges	City councils, water boards

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
Other housing		
House purchase	New homes (excluding land) and major improvements to existing homes, and fixed appliances such as hot water systems, dishwashers	Project House builders, hardware stores, specialist gas and electricity shopfronts, department stores, specialist electrical stores
Property rates and charges	State and local council property based rates and charges except water and sewerage	City/suburban councils
House repairs and maintenance	Materials and labour costs for repairs and maintenance to dwellings	Building suppliers, hardware stores, ABS data

Specific issues

Price collection

Rents

8.67 This subgroup covers rental payments for privately-owned dwellings as well as rental payments for government-owned dwellings. Rental payments for holiday homes are excluded as these are classified under the Domestic holiday travel and accommodation expenditure class of the Recreation group. Prices for a sample of rented dwellings within each capital city are collected every quarter, with the sample stratified according to geographical location, size of dwelling and wall type based on the most recent Census of Population and Housing.

8.68 Rental payments for privately-owned dwellings in the metropolitan areas of each capital city are obtained from real estate agents under a matched sample approach, i.e. prices are collected in respect of the same sample of private rental dwellings every quarter.

8.69 Government rents charged to pensioners and other welfare recipients are set as a proportion of income. As such incomes are known, rents for government housing are derived from information provided by the relevant housing authority. Consequently, price movements can be readily estimated. Occasionally, the proportion used to set rents is changed. Again this is public knowledge and so is readily available for use in estimating price movements.

Utilities

8.70 Electricity, gas, water and sewerage charges are obtained quarterly from the energy authorities and local councils, and both concession and non-concession rates are priced. Connection fees, delivery and other related charges are included as part of the price of the utility service. Governments and councils occasionally impose levies on customers for these services as a means of raising money for some, possibly unrelated, service (e.g. ambulance levy, emergency services levy). As these levies are considered an inescapable cost of obtaining the original service they are counted as a part of the cost of the original service.

8.71 Prices for other household fuels (heating oil, firewood and bottled gas) are collected quarterly from retail outlets selling such products.

Other housing

8.72 Pricing of house purchases is limited to transactions in newly constructed owner-occupied houses (refer to Chapter 6 for an explanation as to why only new dwellings are priced) and is conducted monthly. A sample of project home builders is approached each quarter to obtain prices for a number of specified types and models of project homes. The types of project homes selected are those most commonly constructed in each city. For marketing purposes, many builders provide bonus deals, which can involve upgrades to fittings, extra features or even extra rooms. These bonuses change frequently and due to this price volatility, new homes are priced monthly.

8.73 Extensions and renovations are also part of this expenditure class. However, no prices specifically relating to these activities are collected, as the costs are assumed to move similarly to new house building costs. Expenditure on these services is included in the weight for this expenditure class.

8.74 Property rates and charges are normally set on the basis of a rating year and are therefore only priced once a year. Examples of items priced are general rates, land taxes and garbage collection fees. Where concessional and non-concessional rates exist, both rates are priced. Although the procedure is to price rates once a year, local councils are contacted every quarter to confirm that changes have not been made to the rates and other charges set at the beginning of the rating year.

8.75 Prices for house repairs and maintenance work performed by tradesmen are not collected as prices for complete tasks, but are estimated using the labour cost index and the price movements for various building materials.

Subsidies

8.76 In the case of house purchases, certain classes of home buyers are eligible for government subsidies directly related to the home purchase. Adjustments are made to the prices collected to reflect the different transaction prices paid by the different classes of home buyers.

Quality

8.77 Significant maintenance tasks on rented dwellings (for instance, new carpet) are normally carried out infrequently. As a consequence, the resultant rent increases, due to the cost-recovery aspects of these activities, occur at irregular intervals rather than as a continuous series of small increases. Since the work was carried out to return the dwelling to its original relative standard and given no quality adjustments are made to the rents collected to take account of the slow deterioration in quality of the dwelling some large rent increases are accepted without any adjustment.

8.78 Conceptually, when a change in the quality of a rented dwelling occurs (for example, a new garage is added) a price adjustment will be required to account for the quality change. Information to assist in making adjustments for these quality changes is obtained from the real estate agents who supply the price. Collecting information on quality changes for government-owned rented dwellings has not been feasible because the improvement in quality is usually not directly reflected in the rental charges. In practice, the effect of the quality changes is deemed to be minor and no quality adjustments are applied to government-owned rented dwellings.

HOUSEHOLD FURNISHINGS, SUPPLIES AND SERVICES

8.79 Conceptually, the Household furnishings, supplies and services group covers expenditure on all goods and services used in the operation and regular use of dwellings. At the time of the 14th series review, the group accounted for approximately 8 per cent of the CPI basket of goods and services.

TABLE 8.5: HOUSEHOLD FURNISHINGS, SUPPLIES AND SERVICES GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
HOUSEHOLD FURNISHINGS, SUPPLIES AND SERVICES		
Furniture and furnishings		
Furniture	All household furniture (including outdoors), lamps, ornaments and blinds	Furniture stores, department stores, BBQ and outdoor specialists
Floor and window coverings	All floor and window coverings and ceramic and vinyl tiles	Furniture stores, carpet & tile specialists, fabric stores, department stores
Towels and linen	Bathroom, bedroom, table and kitchen linen, blankets, pillows	Department stores, homewares & fabric stores
Household appliances, utensils and tools		
Major household appliances	Purchase, hire and repair of all major 'white' goods not permanently fixed such as refrigerators and washing machines	Department stores, furniture stores, electrical & appliance stores
Small electric household appliances	Purchase, hire and repair of smaller electrical appliances such as toasters and vacuum cleaners	Department stores, furniture stores, electrical & appliance stores
Glassware, tableware and household utensils	Dinner sets, cutlery, stoneware, steak knives, pots, pans, cookware, brooms and mops	Department stores, homewares stores, jewellers
Tools	Lawnmowers, garden tools, electric drills and paint brushes	Department stores, hardware stores

8.80 Table 8.5 shows the structure of the Household furnishings, supplies and services group. Examples of products priced and the source of the data are also shown in the table.

Specific issues

Price collection

8.81 All products covered by this group are priced quarterly. Large products (such as lounge suites, beds and refrigerators) are normally offered with an extra charge for home delivery. For CPI purposes, these delivery fees are included in the price of the article as, for most consumers, it can be considered an inescapable cost of purchasing these items.

8.82 Household services are often charged by the hour. This is not an appropriate pricing measure for CPI purposes, as it makes no allowance for improvements in efficiency in service provision. Respondents are requested to provide prices for completed typical jobs in order to overcome this problem. The chosen task is repriced for the same client every quarter. Prices for both casual and permanent clients are obtained.

Quality adjustment

8.83 Services present a problem in regards to repeated pricing of a constant quality of product. To meet our requirement, respondents are asked to select a property and to provide a costing for the provisions of a completed job for a popular service to that property. This overcomes problems with simple measures such as hourly rates (where for example, more experienced people can perform a given task more quickly).

8.84 Furniture also presents a problem in pricing to constant quality as, for example, the quality of construction may change but not be noticeable from a casual inspection. Fashion also plays a large part in new models without modifying the practical utility of the product to the consumer. Without a change in utility, changes in fashion do not result in prices being adjusted for quality changes.

8.85 Products like cleaning agents often have their formulas changed and, as a result, their prices change. If the change to formulas is driven by legislation (e.g. changes to poisons laws to improve child safety) then no adjustment to prices for quality is made unless there is a demonstrated change to the efficiency of the product to perform the service for which it was purchased. Similarly, if the change to the product is for the overall benefit of the community (e.g. biodegradable cleaning agents) then, again, no adjustment for quality is made.

HEALTH

8.86 The Health group includes all expenditure relating to health products and health services. This group accounted for nearly 5 per cent of the CPI basket in value at the time of the 14th series review.

8.87 Table 8.6 shows the structure of the Health group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.6: HEALTH GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
HEALTH		
Health services		
Hospital and medical services	Medical insurance, doctor and specialist fees, other medical practitioner fees and hospital charges	Department of Health and Ageing, Health Insurance Commission, medical clinics, health funds, hospitals
Optical services	Opticians' fees, optical frames and lenses	Department of Health and Ageing, optical clinics, optometrists
Dental services	Dentists' fees including fillings, consultations, removal of a tooth, removal of plaque	Dental clinics
Pharmaceuticals		
Pharmaceuticals	PBS medicines, non-PBS prescription medicines, analgesics, cold relief, antacid, vitamins, bandaids and antiseptic	Department of Health and Ageing, Health Insurance Commission, pharmacies, supermarkets and grocery stores, other retail outlets

Specific issues

Pricing practices

8.88 All products covered by this group (except health insurance) are priced quarterly. However, the bulk of prices collected for this group are adjusted to net prices (i.e. gross price less Medicare or similar rebate). Of the health services subgroup, only hospital charges for patients with private health insurance and private health insurance premiums are not recorded as net prices. In the Pharmaceuticals subgroup, only medicines purchased under the pharmaceutical benefits scheme (PBS) have net prices recorded.

8.89 Health insurance cover is priced monthly, and included under this subgroup because it directly relates to health services. Conceptually, the cost of the service of insurance should be netted from the premium and recorded with other non-life insurances in the Miscellaneous group. However, this is not practical due mainly to lack of information on the cost of this service.

Areas requiring special pricing procedures

8.90 Under the PBS, consumers pay a standard, subsidised price for medications until they reach a specified level of expenditure (the 'safety net' limit) during a calendar year. Once an individual consumer has reached this limit all further purchases of medications are at a greatly reduced, concessional price. Certain groups of consumers (e.g. age pensioners) do not have to satisfy the safety net provisions and are entitled to pay the concessional prices at all times. Therefore, concessional prices are part of the price sample and are used in index estimation. Price information for prescribed medications covered by the PBS are obtained from the Commonwealth Department of Health and Ageing (DHA). The prices are weighted according to the progressive number of drug prescriptions sold at concessional prices during the four quarters of the year. This factor increases over the year, introducing a distinct seasonal pattern into the average price of PBS drugs.

8.91 Medicare rebates are reviewed once a year and the new levels of rebate are introduced on 1 November each year. Respondents provide gross prices for patients who are not bulk-billed and the corresponding net price is then calculated by the ABS. Information on bulk-billing ratios is obtained from the Health Insurance Commission (HIC).

Adjusting for quality

8.92 The quality of many health care products and services is subject to constant improvement and these improvements need to be taken into account during pricing to maintain the concept of pricing to 'constant quality'. Unfortunately, identifying quality change in health care services is often quite difficult in practice because there are very few observable measures for such services. Many of the quality improvements relate to psychological or physical benefits that would require complex methodologies to determine the effect of the quality change. For these reasons, prices collected for health care services are normally not adjusted for changes in quality unless the change is significant and there are reasonable means of quantifying the quality change.

Subsidies

8.93 A number of health services are subsidised under the Medicare rebate scheme and these subsidies are factored in during the pricing of health care services. The general treatment of subsidies outlined in Chapter 7 is used to adjust the cost of the service to a net price. Data relating to the amount of subsidies for health services is obtained from the DHA on a quarterly basis to enable the net prices to be calculated.

TRANSPORTATION

8.94 This group includes all expenses related to owning and operating motor vehicles in private ownership and all private travel by all forms of public transport operating within the capital cities. It does not cover public transport used for inter-city travel: this is covered in the Recreation group. The Transportation group accounted for approximately 15 per cent of the CPI basket in value at the time of the 14th series review.

8.95 Table 8.7 shows the structure of the Transportation group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.7: TRANSPORTATION GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
TRANSPORTATION		
Private motoring		
Motor vehicles	Purchase and long term hire/lease of new cars and motor cycles	Car dealerships and motorcycle dealerships
Automotive fuel	Unleaded petrol, lead replacement petrol, diesel, LPG	Petrol stations
Motor vehicle repair and servicing	Crash repairs, panel beating, tune ups and maintenance	Insurance companies, car dealerships
Motor vehicle parts and accessories	Separately purchased parts and accessories, motor oils and tyres	Car dealerships, car part & accessories stores
Other motoring charges	Registration fees, parking fees, driving lessons, tollway charges	Carparks, city councils and other government bodies
Urban transport fares		
Urban transport fares	Bus, train, ferry, tram and taxi fares, not for holiday travel	Government transport authorities; taxi, bus, train and tram companies

Specific issues

Pricing practices

8.96 Prices for all goods and services in Transportation, except for motor cars and automotive fuel, are collected quarterly.

8.97 Prices of new cars are collected monthly. Cars included in the price sample cover a broad selection of Australian-made and imported 2 and 4 wheel drive models across a wide spectrum of price levels (refer to Chapter 7 for an explanation of why second-hand cars are not priced). All taxes and levies associated with the purchase of a car, other than vehicle registration, are included in the recorded price.

8.98 Automotive fuel prices are obtained as a sample of electronic funds transfer (EFT) transactions conducted in each city. Prices from outlets across all regions within each city are obtained each day, including weekends and public holidays. Prices for unleaded petrol, lead replacement petrol, LPG and diesel are collected.

Areas requiring special pricing procedures

8.99 Motor cars are very seldom sold at the recommended retail (or list) price. There is usually some bonus deal (e.g. free air-conditioning, 'drive-away' or a heavily discounted accessories package) associated with the sale or just simple haggling over price. Since actual transaction prices are required for the CPI, field officers determine from discussions with car dealers an estimate of the average value of these deals.

8.100 To price public transport, fares for a sample of representative journeys are collected, in preference to prices of various ticket types or zones. For all routes, a mix of ticket types (e.g. single, periodical, concessional and multi-trip tickets) is priced.

Quality adjustment

8.101 Whenever any specification change is made to a vehicle that affects its motoring performance, economy, comfort level, safety or durability (i.e. a change which affects the quality of the vehicle), an adjustment is made to the car's reported price to allow for that portion of the price change that can be attributed to the quality change. In practice, these price adjustments are made at the time of the change or new model release.

8.102 Quality adjustments for motor vehicles are determined on the basis of consumer utility and measures of this are derived from a variety of sources, including:

- Industry-conducted market research to determine consumers' desires for new accessories or improved features.
- Price lists for a now-standard accessory which was formerly offered as an option. The relevance of that option price, however, is carefully considered in the context of the charging rate for fitting the accessory when offered only as an option.

8.103 Consistency of adjustment practices is maintained across vehicles and over time but allowance is made for changing community perceptions of utility.

8.104 No adjustments are made to prices for public transport for changes in quality of service such as improved timetables or better seating.

COMMUNICATION

8.105 This group covers all expenditure related to telecommunication services and postal services. The Communication group accounted for approximately 3 per cent of the CPI basket in value terms at the time of the 14th series review.

8.106 Table 8.8 shows the structure of the Communication group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.8: COMMUNICATION GROUP INDEX STRUCTURE

Group, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
COMMUNICATION		
Postal	Stamps and postal delivery charges	Australia Post
Telecommunication	Local, long distance and international calls, mobile phone services, connection fees and Internet services	Suppliers of telecommunications services

Specific issues

Price collection

8.107 Prices for postal services are collected once every month. They cover a range of postal charges including those for standard letters, common sized parcels and international mail. The prices are collected centrally as the charges apply nation-wide.

8.108 Prices for communication services are also collected centrally as prices for particular services normally do not vary between cities. Price collection is conducted monthly from a sample of telecommunication providers.

Areas requiring special pricing procedures

8.109 It is difficult to price 'bundled packages' on a constant quality basis where charging rates are linked to frequency of use or duration of the telephone calls. In these cases, the rate of discount often varies according to usage, which makes it difficult to select the appropriate level of use upon which to base the price movement measure.[68] Pricing of the individual services is used to estimate overall price movement.

8.110 The prospect of broader 'bundling', where single suppliers provide packages which combine together different types of services (e.g. telephone services, subscription television services and broadband Internet services) is likely to cause more problems. It would be very difficult to determine the price movement of the components in the bundle separately, as well as identifying and adjusting for quality change according to each particular type of service. This problem will be particularly troublesome when the services overlap different CPI groups. The ABS will continue to monitor developments and seek to identify methods for dealing with this issue.

Adjusting for quality

8.111 One of the most difficult issues related to pricing telecommunication services is attempting to price the services on a 'constant quality' basis. Service providers are constantly developing new pricing plans to counter competitive pressures, (e.g. offering different mixes of services). In concept, these changes should be incorporated into price calculations to ensure that telecommunications services are priced to a constant quality. However, there are practical difficulties involved in attempting to adjust for these changes as plans are often charged on a complete suite of services basis. As such, prices for the individual components of the plan are usually not separately available. In these cases, it is often difficult when comparing different plans or modifications to the composition of plans to objectively separate the individual services or quality change from the 'pure' price change.

RECREATION

8.112 All expenditure on recreational products, sporting and recreational activities, holiday travel and holiday accommodation is included in the Recreation group. The Recreation group accounted for approximately 12 per cent of the CPI basket at the time of the 14th series review.

8.113 Table 8.9 shows the structure of the Recreation group. Examples of products priced and the source of the data are also shown in the table.

[68] A possible method that could be used to overcome this problem is to obtain a sample of customer bills and to reprice the bills at current charging rates for several periods. This would provide a constant usage behaviour from which to measure price movements between different quarters. This method is currently under investigation by the ABS.

TABLE 8.9: RECREATION GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
RECREATION		
Audio, visual and computing		
Audio, visual and computer equipment	Equipment including televisions, videos, computer hardware and stereos	Hi-fi shops and entertainment goods retailers, large department stores, US Bureau of Labor Statistics
Audio, visual and computing media and services	Media including blank and pre-recorded cassettes, video tape & DVD rental , CDs, computer software, photographic film, all forms of stationery, and services such as film developing, pay television	Hi-fi shops and entertainment goods retailers, large department stores, US Bureau of Labor Statistics, stationary stores
Books, newspapers, magazines		
Books	Adults' and children's fiction and non-fiction, hardback and paperback	Major book retailer chain stores, discount bookshops, large department stores
Newspapers and magazines	Newspapers, comics, magazines and catalogues	Newsagents, Internet
Sports and other recreation		
Sports and recreational equipment	Purchase and repair of equipment used in playing sport (including specialist footwear) and for recreation, including camping equipment	Sports equipment stores
Toys, games and hobbies	TV games, musical instruments, board games	Large toy shops, department stores
Sports participation	Fees and charges for playing sport including lessons, ground fees, gym fees, equipment hire	Clubs, organisations providing sporting activities
Pets, pet foods and supplies	Pet foods, aquariums and other items for the housing and care of pets	Supermarkets, pet stores, large toy shops
Pet services including veterinary	Services to care for animals, including veterinary, kennel and stable fees	Veterinary clinics
Other recreational activities	Other recreation and entertainment expenses including, admission fees (e.g. cinema, national parks, video arcades)	Cinemas, concert halls, theatres

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
Holiday travel and accommodation		
Domestic holiday travel and accommodation	Air, sea and rail travel, car hire, hotel and motel accommodation and package charges for holidays in Australia	Travel agents, hotels, motels, caravan parks, Internet
Overseas holiday travel and accommodation	Air, sea and rail travel, car hire, hotel and motel accommodation and package charges for holidays overseas	Travel agents

Specific issues

Price collection

8.114 Most products in this group are priced quarterly. The exceptions are holiday travel and accommodation, computer equipment and software, and newspapers and magazines, which are priced monthly. Prices for newspapers and magazines, computer equipment and software, overseas tours and domestic air fares are collected centrally. Prices for all other products are collected locally. Field officers collect prices for holiday accommodation from respondents in their own state even though many of these prices will be used to calculate indexes for cities other than their own.

Areas requiring special pricing procedures

Audio, visual and computing products and services

8.115 The ABS does not directly price computer equipment purchased by the CPI population because of the complexity involved in pricing such products. Instead, the price movement is estimated using the US Bureau of Labor Statistics (BLS) personal computer and peripheral equipment index for the hardware component and the BLS computer software and accessories index for the software component. The BLS indexes are calculated hedonically to account for quality changes in computers and software over time. Adjustments are made to the BLS indexes to allow for exchange rate influences and a lag is applied to account for the time taken to ship the computer products to Australia from the USA. The ABS is investigating the feasibility of introducing an Australian hedonic function to price computers.

Books, newspapers and magazines

8.116 Book prices for the CPI are based on the actual transaction prices paid by consumers and not the recommended retail prices stated on the books. In the case of books sold through book clubs and mail order outlets, discounts are often available but are normally based on the total dollar value of book purchases. If the discounts do not relate specifically to a particular book, they are not recorded for the CPI.

Sports and other recreation

8.117 Toys and games are subject to fashion changes, making it difficult to price a particular toy over a long period. To deal with such problems, mainly long-term favourite toys and games are priced. Regular discussions are held with manufacturers to ensure that the appropriate items are priced.

Holiday travel and accommodation

8.118 Domestic holiday travel prices and overseas holiday travel prices are collected separately because, in general, they are influenced by different factors. For example, changes in the foreign currency exchange rate are likely to affect overseas travel prices quite significantly but will only have a minimal effect on domestic travel prices. In contrast, Australian school holidays will have a major impact on the cost of holiday accommodation within Australia but will have minimal impact on overseas travel prices.

8.119 Most holiday travel, particularly airfares, is booked in advance. Prices for airfares also tend to vary depending on how far they are booked in advance. As the Australian CPI is compiled on an acquisitions basis, air fares are collected in advance (at the time of payment) and lagged so that, when the index is calculated, the price movement matches the time when the travel would be undertaken rather than the time at which the ticket was purchased.

Quality adjustment

Audio, visual and computing products and services

8.120 Audio and visual products are subject to frequent changes in styles and models. These changes quite often improve the quality of the products. Where the product currently priced for the CPI has been subject to such changes, an adjustment is made to ensure that the concept of pricing to 'constant quality' is maintained.

8.121 Computer products are likely to continue experiencing significant technological and quality improvements and conceptually, these changes will need to be reflected in the CPI prices. Since the ABS estimates are based on the US BLS computer indexes, no quality adjustments are made to the ABS price estimates as quality changes would have already been taken into consideration in the BLS indexes.

Books, newspapers and magazines

8.122 Collecting book prices on a 'constant quality' basis over an extended period of time can be a problem for particular types of books, for instance, fiction titles. Books on the top 10 best-seller lists are used as a guide to select books for pricing but the popularity of these titles is likely to decline after a period of time. When that happens a replacement with identical quality and specifications will be required. However, books in the top 10 best-seller lists are usually not comparable to one another in terms of size, content and price and finding a suitable replacement can be difficult. One of the strategies the ABS adopts to minimise the problem is to price books by particular authors who have been producing similar quality best selling novels over a relatively long period of time.

Sports and other recreation

8.123 Measuring the change in quality of recreational activities such as attending a concert or watching a movie is very subjective as the change in utility resulting from a better concert or movie is likely to differ between individuals. However, the variation in utility is considered to not be very significant and no quality adjustments are applied. Items that have a time component (e.g. club membership) will be adjusted if the time component of the service being bought changes significantly.

Holiday travel and accommodation

8.124 Measuring quality change in holiday travel is also a highly subjective task. For example, it is very difficult to gauge the quality change resulting from improved seating in aeroplanes or better quality hotel rooms being included in holiday/airfare packages. Quality adjustments are generally not applied to holiday travel items unless the quality change is significant and there are reasonable means of quantifying the change.

Seasonal factors

8.125 Certain types of books and some types of sports or recreational activities are affected by seasonal factors and are available for certain time periods only. For example, many university textbooks are available at the beginning of the education year only. In this case, the university textbook prices in other pricing periods will be imputed based on the prices of similar items that are available. Where annual subscriptions are concerned, prices are carried forward until the same quarter in the following year when the subscription will next be priced.

EDUCATION

8.126 The Education group includes all expenditure on primary, secondary and tertiary education, and preschool services. It accounted for just under 3 per cent of the CPI basket, by value, at the time of the 14th series review.

8.127 Table 8.10 shows the structure of the Education group. Examples of products priced and the source of the data are also shown in the table.

TABLE 8.10: EDUCATION GROUP INDEX STRUCTURE

Group, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
EDUCATION		
Preschool and primary education	Private and government preschool and primary education fees	Preschools, child-care centres, private and government primary schools
Secondary education	Private and government secondary education fees	Private and government secondary schools
Tertiary education	Private and government tertiary education fees	TAFE fees, HECS fees, university admission fees

Specific issues

Price collection

8.128 Preschool education prices are collected from traditional preschool education centres and child-care centres that provide preschool education. Unlike fees charged by the traditional preschool education centres, fees paid for preschool care offered through child-care centres are eligible for the child-care rebate (refer to the section on subsidies later in the Chapter). Eligibility for the rebate is determined by family income level and prices are adjusted to a net basis.

8.129 Fees for primary and secondary education are collected from both government and private schools. Prices are collected only at the commencement of the school year, since fees are reviewed only once a year. The fees are separated into 'Tuition fees' and 'Other fees'. Included under the component 'Other fees' are charges associated with attending the school but which are not normally considered to be part of tuition fees although they must be paid. Examples of these fees are book fees, payments for excursion trips, school building funds, camp fees and swimming lesson fees.

8.130 Tertiary education fees are collected from universities, and Technical and Further Education (TAFE) colleges. Fees are divided into 'Course fees' and 'Administration fees'. Common items included in 'Administration fees' are enrolment fees, book and library fees, and student association fees.

8.131 The Australian government charges all tertiary students a compulsory service fee under the Higher Education Contribution Scheme (HECS). For CPI purposes, HECS is treated as a cost directly related to tertiary education and so it is included as part of tertiary education fees. HECS payments data are obtained from the Commonwealth Department of Education, Science and Training.

Subsidies

8.132 Child-care benefits are payments made by the Australian government to assist working Australian parents meet the cost of leaving their children in preschool care centres while they are at work. For CPI purposes, the child-care benefit payable for preschool care is deemed to be a subsidy directly related to cost of preschool education and in accordance with the principles stated in Chapter 7, the subsidy is deducted, where applicable, to arrive at a 'net fee'.

Quality adjustment

8.133 Applying quality adjustment to educational services can be very subjective as the factors determining the quality of the services are very difficult to measure. Factors affecting the quality of education include the standard of teaching skills and the quality of the equipment provided to students. These factors can have an impact on the quality of the service but no quality adjustments are made for such changes due to the problems associated with measuring them accurately.

8.134 However, the introduction of new charges or fees is an area where quality adjustment is sometimes applied. If the extra charge or fee is accompanied by an improvement in the quality of education, the change in quality will need to be adjusted out in accordance with the concept of pricing to 'constant quality'. A typical example is when a school decides to introduce a building fund fee to cover the construction of a new extension to the school building. If the building extension results in a better learning environment, which improves the quality of the students' education, the fee increase will be treated as a quality change. In many cases, however, it is difficult to determine whether the new fee payment is related entirely to a change in the quality of education or a pure price rise, or a combination of both. For this reason, the treatment of new fees and charges is decided on a case-by-case basis.

MISCELLANEOUS

8.135 Goods and services priced in this group include expenditure on non-life insurance services (other than health insurance), personal care goods and services, and child-care services. The Miscellaneous group accounted for approximately 4 per cent of the CPI basket at the time of the 14th series review.

8.136 Table 8.11 shows the structure of the Miscellaneous group. Examples of items priced and the sources of the data are also included in the table.

TABLE 8.11: MISCELLANEOUS GROUP INDEX STRUCTURE

Group, subgroup, expenditure class	*Examples of items priced*	*Outlets/source of price collection*
MISCELLANEOUS		
Insurance services		
Insurance services	Motor vehicle insurance, household property and contents insurance	Insurance companies
Personal care		
Hairdressing & personal care services	Hairdressing services, manicures	Hairdressers, health shops
Toiletries & personal care products	Cosmetics, oral hygiene products (e.g. toothpaste), hair care products (e.g. shampoos), soaps, body deodorants	Department stores, supermarkets, pharmacies
Child care		
Child care	Full-time and part-time child care	Community and private child-care centres, family day care schemes

Specific issues

Price collection

8.137 All products in this group are priced once every quarter. Field officers collect the prices via personal visits to the relevant organisations.

8.138 Included under insurance services are motor vehicle insurance, household property and contents insurance (health care insurance is excluded from this group and is classified under the Health group). To monitor price movements of insurance services, representative ranges of different risk categories are priced for insurance cover and are collected quarterly. The risks vary due to different demographics of the insured consumer (e.g. for vehicle insurance) or due to location within various risk zones in a city. Taxes and other government fees and charges associated with the provision of the insurance service (e.g. stamp duty) are collected as part of the premium because they are an inescapable cost of purchasing the insurance service.

8.139 Child-care services priced cover full-time, part-time and occasional care. Respondents are selected from each of the community-based, private company and family-based day care sectors of the industry.

Areas requiring special pricing procedures

8.140 Due to the practical difficulties associated with collecting the estimated cost of the insurance service as a net premium, the gross insurance premium is collected as a suitable proxy value from which to measure price movement. Generally, the assumption underlying this practice, that the cost of the insurance service is proportional to the premium, will hold and so the proxy is representative over the long term. However, occasionally factors that influence the gross premium, but not the true insurance service cost, may change. For example, an unexpected catastrophic natural disaster may raise significantly the proportion of consumers making claims. However, the individual cost of servicing these claims would not be affected. Following the event, companies might raise gross premiums to recover the unexpected claim payments.

Subsidies

8.141 Parents with children in approved child-care centres are eligible to claim child-care benefits, with the amount of benefit received determined according to their income levels. The benefits are subsidies directly related to child-care services and so the conceptual treatment of subsidies outlined in Chapter 7 is met. As the amount of benefit received by parents varies according to income, the collected gross fees are adjusted to net fees using an income-based model. The model is adjusted over time to reflect changes in aggregate income levels and changes in the benefit rates.

Quality adjustment

8.142 To ensure that the requested insurance cover is of 'constant quality' over time, the values of the contents, properties and vehicles represented by the specifications are updated on a regular basis to maintain a real level of value. The ABS regularly discusses these valuations with the insurance companies to ensure that representative insured valuations are used for pricing.

8.143 Personal care services are difficult to adjust for changes in quality. For example, trying to assess the change in the quality of a haircut (due to change in style rather than competence of the hairdresser) would be highly subjective. As a result, quality adjustments are rarely applied to personal care services.

8.144 Changes in the quality of child care are also difficult to assess because of the subjective nature of measuring effects such as changes in staff experience and training. Therefore, no quality adjustments are made for such changes.

CHAPTER 9 COMPILING THE CPI

INTRODUCTION

9.1 The CPI has previously been described in terms of a basket of goods and services, which is 'purchased' each quarter. As prices change from one quarter to the next so too will the total cost (or price) of the basket. Of the various ways in which a CPI could be described, this description conforms closely with the procedures actually followed.

9.2 Using this description, the CPI can be thought of as being constructed in five major steps:

(i) subdividing the total expenditure into individual items for which price samples can be selected

(ii) collecting price data

(iii) estimating price movements for individual items

(iv) calculating the current period cost of the basket

(v) calculating index numbers and points contribution.

9.3 This Chapter provides a stylised account of the various steps above. It also indicates how analytical indexes are calculated and the ABS rounding practices.

SUBDIVIDING THE BASKET

Expenditure aggregates

9.4 Based mainly on the Household Expenditure Survey (HES) results, estimates are obtained for total annual expenditure of private households in each capital city for each of the 89 expenditure classes in the CPI. As these estimates relate to the expenditure of households in aggregate, they are referred to as 'expenditure aggregates'.

9.5 Expenditure aggregates are derived for well-defined categories of household expenditure (e.g. bread), but are still too broad to be of direct use in selecting samples of products for pricing. For this purpose, expenditure aggregates need to be subdivided into as fine a level of commodity detail as possible. As the HES is generally not designed to provide such fine level estimates, it is necessary to supplement the HES data with information from other sources such as other official data collections and industry data. The processes involved are illustrated below by reference to a hypothetical example for the Bread expenditure class of the CPI.

9.6 Suppose that, based on information reported in the HES, the annual expenditure on bread by all private households in a particular city is estimated at $8 million. Further, suppose that some industry data exists on the market shares of various types of bread. In combination, these two data sources can be used to derive expenditure aggregates at a much finer level of detail than that available from the HES alone. The hypothetical results are shown in table 9.1.

9.7 The next stage in the process involves determining the types of bread for which price samples should be constructed. This is not a simple exercise and relies heavily on the judgement of the prices statisticians. In reaching decisions about precisely which items to include in price samples, a balance needs to be struck between the cost of data collection (and processing) and the accuracy of the index. Factors taken into account include the relative significance of individual items, the extent to which different items are likely to exhibit similar price behaviour, and any practical problems associated with measuring prices to constant quality.

TABLE 9.1: DISAGGREGATION OF EXPENDITURE DATA

	Type of bread	*Market Share*	*HES data*	*Derived expenditure aggregates*
		%	$'000	$'000
1	White, sandwich, sliced	30	—	2,400
2	White, sandwich, unsliced	2	—	160
3	White high fibre	20	—	1,600
4	White high top	3	—	240
5	Wholemeal	10	—	800
6	Multigrain	15	—	1,200
7	Bread rolls	15	—	1,200
8	Specialty	5	—	400
	Total Bread	**100**	**8,000**	**8,000**

9.8 In this example, a reasonable outcome would be to decide to construct pricing samples for varieties 1, 3, 5 and 6. Separate pricing samples would not be constructed for items 2 and 4 due to their relatively small market share. Pricing samples would also not be constructed for bread rolls and specialty breads (items 7 and 8) as they would prove difficult to price to constant quality due to the tendency for these items to be sold by number rather than weight.

Elementary aggregates must have a price sample

9.9 When no more information is available to further disaggregate the expenditure values, the resulting product definitions are called elementary aggregates. Each elementary aggregate has its own price sample. Ideally, all the products covered (and there should only be a few) would be homogeneous goods or services and would be substitutes for each other. In the Australian CPI there are approximately 1,000 elementary aggregates for each of the eight capital cities. This gives around 8,000 price samples at the national level. The expenditure aggregates for the items that are not explicitly priced are reallocated across the elementary aggregates of closely related goods or services under the assumption that the price movements for these products will be similar.

9.10 In the bread example, the reallocation would be carried out in two stages. First, the expenditure aggregate for unsliced white sandwich loaves would be added to sliced white sandwich loaves resulting in an elementary aggregate for white sandwich loaves (as it will be the characteristics of being white and sandwich loaves that make them likely to experience similar price movement pressures). White high fibre loaves would be treated similarly. In the second stage, the expenditure aggregates for bread rolls and speciality breads, which have no closely matching characteristics with any of the other types of bread, would be allocated, on a proportional basis, across the remaining elementary aggregates under the assumption that the average movement of prices for all other bread types will be the best estimate. This outcome of this process is presented in table 9.2.

9.11 In summary, the rationale for this allocation is as follows. Price behaviour of item 2 (white, sandwich, unsliced) is likely to be best represented by the price behaviour of item 1 (white, sandwich, sliced). Items 4 (white high top) and 3 (white high fibre) are treated similarly. The price behaviour for items 7 and 8 (bread rolls and specialty bread respectively) is likely to be best represented by the average price behaviour of all other breads.

TABLE 9.2: OUTCOME OF ELEMENTARY AGGREGATE RATIONALISATION

Bread type	*Expenditure aggregates*			*Elementary aggregate*
	Initial	*Stage 1*	*Stage 2*	
	$'000	*$'000*	*$'000*	
1	2,400	2,560	3,200	White sandwich
2	160	—	—	
3	1,600	1,840	2,300	White high fibre
4	240	—	—	
5	800	800	1,000	Wholemeal
6	1,200	1,200	1,500	Multigrain
7	1,200	1,200	—	
8	400	400	—	
Total	**8,000**	**8,000**	**8,000**	

Determining outlet types

9.12 Having settled on the product definitions for which price samples are to be constructed, the next step is to determine the outlet types (respondents) from which prices will be collected. In order to accurately reflect changes in prices paid by households for bread, prices need to be collected from the various types of outlets from which households purchase bread. Data are unlikely to be available on the expenditures at the individual elementary aggregate level by type of outlet. It is more likely that data will be available for expenditure on bread in total by type of outlet. Suppose industry data indicates that supermarkets accounted for about 80% of bread sales and bakery outlets the remainder. A simple way to construct a pricing sample for each elementary aggregate that is representative of household shopping patterns is to have a ratio of four supermarkets to every bakery.

COLLECTING PRICE DATA

Selecting respondents

9.13 When pricing samples have been determined, ABS field staff determine from which individual supermarkets and bakeries the prices will be collected. The individual outlets are chosen to be representative of the two types of outlets taking into account the demographics of the city and the numbers required for the sample. Prices will be collected from any particular respondent at the same time of each collection period (e.g. first Monday of each month).

Selecting items to price

9.14 When a pricing sample contains respondent standard specifications (refer to Chapter 8 for an explanation of this term) field staff will determine, in conjunction with the outlet management, which specific items are most representative of the required type of product. Using the bread example, at one outlet it might be decided that the 680 g sliced white sandwich loaf best represents white sandwich bread while at another outlet it might be a 700 g white sandwich loaf. Once selected, the same product will be priced at that respondent while ever it is the most representative example.

9.15 An important part of the price collection process is the continual monitoring of the items for quality change. In the bread example, quality change could occur with, say, a change in the size (weight) of the loaf of bread. In this case, the price movement directly attributable to the change in loaf size would be removed to derive a pure price movement for the loaf.

ESTIMATION OF PRICE MOVEMENTS FOR ELEMENTARY AGGREGATES

9.16 Price relatives are calculated for each price in the sample and the geometric mean of these is calculated. The ratio of the current period's geometric mean of price relatives to the previous period's geometric mean of price relatives provides the change in the average price for the elementary aggregate. Using the hypothetical bread sample, table 9.3 shows price relatives being used to estimate the price movement for bread. These estimates of price movements are used to revalue the expenditure aggregates to current period prices, by applying period to period price movement to the previous period's expenditure aggregate for each elementary aggregate. The updated expenditure aggregate provides an estimate of the cost of acquiring the base period quantity of the elementary aggregate's products in the current period.[69]

TABLE 9.3: ESTIMATING PRICE MOVEMENT FOR AN ELEMENTARY AGGREGATE

	Price relatives in		
	Period 1	*Period 2*	*Price movement*
			Per cent
White sandwich loaf			
Supermarket A	1.025	1.045	2.0
Supermarket B	1.030	0.950	-7.8
Supermarket C	1.040	1.065	2.4
Supermarket D	0.980	1.100	12.2
Bakery	1.100	1.250	13.6
Geometric mean	1.034	1.075	4.0

CALCULATING THE CURRENT COST OF THE BASKET

9.17 Once price movements are calculated for each item, a geometric mean is calculated, which is used to derive price-updated expenditure aggregates for each elementary aggregate. These are then summed to derive the current cost of the total (or any portion of the) basket of goods and services. Index numbers are calculated from the expenditure aggregates at every level of the index. Table 9.4 shows the calculation of the expenditure value for the total of bread (an expenditure class in the example).

TABLE 9.4: AGGREGATION OF EXPENDITURE AGGREGATES FOR EXPENDITURE CLASS

Elementary aggregate	*Expenditure aggregate Period 1*	*Price change Period 1 to Period 2*	*Expenditure aggregate Period 2*
	$'000	*Per cent*	*$'000*
White sandwich	3,200	4.0	3,328
White high fibre	2,300	3.5	2,381
Wholemeal	1,000	0.0	1,000
Multigrain	1,500	1.7	1,526
Total	8,000	—	8,235

[69] Using terminology from the Laspeyres formula, the expenditure aggregates in period *t* are equivalent to $\sum p_t q_0$. Index values can be derived from the corresponding $\sum p_0 q_0$.

9.18 Once the expenditure aggregates for all the elementary aggregates have been calculated from the price movements, the expenditure aggregates for all higher level components of the index structure are calculated by summing the expenditure aggregates of their components. A cut-down version of a CPI structure, incorporating the bread example, is shown in table 9.5. Price movements in period 2 are used to update the expenditure aggregates.

CALCULATING INDEX NUMBERS AND POINTS CONTRIBUTIONS

9.19 Table 9.5 also shows the calculation of index numbers and points contribution. It has been assumed that index numbers already exist for the link period (June quarter 2000 for the 14th series CPI) and period 1. Assume the expenditure aggregate for Cereals has been calculated using the same method as that for Bread, so that the two can be added and a movement calculated for Bread and cereals. Similarly, assume the expenditure aggregates for period 2 have been calculated for Other Foods and Non-food, so that expenditure aggregates can be calculated for Food and All groups.

9.20 When a price index has not been linked, indexes for any component can be calculated simply by dividing the current period expenditure aggregate by its expenditure aggregate in the reference period (when the index is set to 100.0). However, the CPI has been linked several times since its reference base (1989–90) and the index numbers must be calculated from

$$I_{LP} \times \frac{V_{CP}}{V_{LP}} \qquad (9.1)$$

where I_{LP} is the index number in the link period (June quarter 2000 for the 14th series CPI), and V_{CP} and V_{LP} are the expenditure aggregates in the current period and link periods respectively. Thus the index number for Bread in period 2 is given by 108.0 x 8245 / 6500 = 135.6.

9.21 Points contributions are also calculated using the expenditure aggregates. In any period, the points contribution of a component to the All groups index number is calculated by multiplying the All groups index number for the period by the expenditure aggregate for the component in that period and dividing by the All groups expenditure aggregate for that period. This can be stated algebraically as

$$I_t^{AG} \times \frac{V_t^i}{V_t^{AG}} \qquad (9.2)$$

where I_t^{AG} is the index for All groups in period *t*, V_t^i is the expenditure aggregate for component *i* in period *t* and V_t^{AG} is the expenditure aggregate for All groups in period *t*.

9.22 In the example in Table 9.5, the points contribution for Bread in period 2 is calculated as 141.3 * (8245 / 144278).

9.23 The change in index points contribution for a component between any two periods is found by simply subtracting the points contribution for the previous period from the points contribution for the current period. For example, the change in index points contribution for Bread between periods 1 and 2 is 8.07 - 7.84 = 0.23.

9.24 The CPI publication does not show the expenditure aggregates, but rather the index numbers derived from the expenditure aggregates. Expenditure aggregates vary considerably in size and showing them would make the publication difficult to read and interpret. The published index numbers and points contributions are a convenient presentation of the information.

TABLE 9.5: AGGREGATION OF EXPENDITURE AGGREGATES FOR ENTIRE INDEX

	Link period	*Period 1*	*Period 2*
	Expenditure aggregates		
All groups	122500	138100	144278
Food	32500	40100	41378
Bread and cereals	12500	15000	15525
Bread	6500	8000	8245
Cereals	6000	7000	7280
Other foods	20000	25100	25853
Non-food	90000	98000	102900
	Movement in expenditure aggregates (period 1 to period 2)		
All groups			1.045
Food			1.032
Bread and cereals			1.035
Bread			1.031
Cereals			1.040
Other foods			1.030
Non-food			1.050
	Index numbers		
All groups	120.0	135.3	141.3
Food	115.0	141.9	146.4
Bread and cereals	110.0	132.0	136.6
Bread	108.0	132.9	137.0
Cereals	113.0	131.8	137.1
Other foods	117.0	146.8	151.2
Non-food	125.0	136.1	142.9
	Points contribution		
All groups	120.0	135.3	141.3
Food	31.84	39.29	40.52
Bread and cereals	12.24	14.70	15.20
Bread	6.37	7.84	8.07
Cereals	5.88	6.86	7.13
Other foods	19.59	24.59	25.32
Non-food	88.16	96.01	100.78

Note: it is assumed the reference base period precedes period 1.

SECONDARY INDEXES

9.25 A range of analytical indexes is published for the CPI. These include the 'All groups excluding (each of the groups in turn)' and 'Goods and Services' indexes. They are termed secondary indexes as they use the same weights (or expenditure aggregates) as the CPI — they are compiled from the summation of the appropriate value aggregates. For example, in Table 9.5 the starting point for compiling an index for All groups excluding Bread and cereals would be to add up the value aggregates for Other foods and Non food and then calculate index values as described in the previous section.

TERTIARY INDEXES

9.26 A further range of analytical indexes is compiled from the price samples collected for the CPI. Price indexes compiled under the outlays approach are produced annually for four population sub-groups: Employees; age pensioners; self-funded retirees; and other government transfer recipients. These indexes, unlike the secondary indexes mentioned above, have their own weighting patterns and are compiled in a similar manner to the CPI. The purpose of the population sub-group indexes is to show any differences in the price changes faced by the four demographic groups, which would arise purely from their differing expenditure patterns.

ABS ROUNDING CONVENTIONS

9.27 To ensure consistency in the application of data produced from the CPI, it is necessary for the ABS to adopt a set of consistent rounding conventions or rules for calculating and presenting data. The conventions strike a balance between maximising the usefulness of the data for analytical purposes and retaining a sense of the underlying precision of the estimates. These conventions need to be taken into account when CPI data is used for analytical or other special purposes.

9.28 Index numbers are always published to a base of 100.0. Index numbers and percentage changes are always published to one decimal place, with the percentage changes being calculated from the rounded index numbers. Points contributions are published to two decimal places, with points contributions change being calculated from the rounded points contributions. Index numbers for periods longer than a single quarter (e.g. for financial years) are calculated as the simple arithmetic average of the relevant rounded quarterly index numbers.

CHAPTER 10 USING THE CPI

INTRODUCTION

10.1 Three broad uses for the CPI were discussed in Chapter 4. In Chapter 5 it was explained that the Australian CPI, from the 13th series onwards, is intended as a measure of price inflation for the household sector. A measure of price inflation is most appropriate in economic policy analysis, forecasting and budgeting. A price inflation measure may also be appropriate in various indexation type roles.

10.2 This Chapter concentrates on the numerical 'how to' type matters. For example it explains the differences between index points and percentage changes, how to determine the major movers in the CPI and how to construct index series from components of the CPI. It provides some practical information on the use of the CPI in contracts and outlines other price indexes produced by the ABS. The final section of the Chapter discusses circumstances in which it may or may not be appropriate to use the CPI or its components.

INTERPRETING INDEX NUMBERS

Index points and percentage changes

10.3 Movements in indexes from one period to any other period can be expressed either as changes in index points or as percentage changes. The following example illustrates these calculations for the All groups CPI (weighted average of the eight capital cities) between the September quarter 1998 and the September quarter 2000. The same procedure is applicable for any two periods.

	Index numbers:
September quarter 2000	130.9
less September quarter 1998	121.3
equals change in index points	9.6

Percentage change = 9.6 / 121.3 x 100 = 7.9%

10.4 For most applications, movements in price indexes are best calculated and presented in terms of percentage change. Percentage change allows comparisons in movements that are independent of the level of the index. For example, a change of 2 index points when the index number is 120 is equivalent to a change of 1.7 per cent, but if the index number were 80 a change of 2 index points would be equivalent to a change of 2.5 per cent — a significantly different rate of price change. Only when evaluating change from the base period of the index will the points change be numerically identical to the percentage change.

10.5 The percentage change between any two periods *must* be calculated, as in the example above, by direct reference to the index numbers for the two periods. Adding the individual quarterly percentage changes will not result in the correct measure of longer-term percentage change. That is, the percentage change between, say, the June quarter one year and the June quarter of the following year will not necessarily equal the sum of the four quarterly percentage changes. The error becomes more noticeable the longer the period covered and the greater the rate of change in the index. This can readily be verified by starting with an index of 100 and increasing it by 10 per cent (multiplying by 1.1) each period. After four periods, the index will equal 146.4 delivering an annual percentage change of 46.4 per cent, not the 40 per cent obtained by adding the four quarterly changes of 10 per cent.

10.6 Although the CPI is compiled and published as a series of quarterly index numbers, its use is not restricted to the measurement of price change between particular quarters. A quarterly index number can be interpreted as representing the average price during the quarter (relative to the base period), index numbers for periods spanning more than one quarter can be calculated as the simple (arithmetic) average of the relevant quarterly indexes. For example, an index number for the year 1998 would be calculated as the arithmetic average of the index numbers for the March, June, September and December quarters of 1998.

10.7 This characteristic of index numbers is particularly useful. It allows for comparison of average prices in one year (calendar or financial) with those in any other year. It also enables prices in, say, the current quarter to be compared with the average prevailing in some prior year.

10.8 The quarterly change in the All groups CPI represents the weighted average price change of all the items included in the CPI. Publication of index numbers and percentage changes for components of the CPI are useful in their own right. However, these data are often not sufficient to enable important contributors to overall price change to be reliably identified. What is required is some measure that encapsulates both an item's price change and its relative importance in the index.

10.9 If the All groups index number is thought of as being derived as the weighted average of the indexes for all its component items, then the index number for a component multiplied by its weight to the All groups index results in what is called its 'points contribution'. It follows that the change in a component item's points contribution from one period to the next provides a direct measure of the contribution to the change in the All groups index resulting from the change in that component's price.

10.10 Information on points contribution and points contribution change, is of immense value when analysing sources of price change and for answering 'what if' type questions. Consider the following data extracted from the September quarter 2000 CPI publication:

TABLE 10.1: SELECTED VALUES FROM CPI PUBLICATION, SEPTEMBER QUARTER 2000

	Index numbers		Percent change	Points contribution		Points change
Item	June qtr	Sept. qtr		June qtr	Sept. qtr	
All groups	126.2	130.9	3.7	126.2	130.9	4.7
Beer	141.4	148.2	4.8	3.04	3.18	0.14

10.11 Using only the index numbers themselves, the most that can be said is that between the June and September quarters 2000, the price of beer increased by more than the overall CPI (by 4.8 per cent compared with an increase in the All groups of 3.7 per cent). The additional information on points contribution and points change can be used to:

- ***Calculate the effective weight for beer in the June and September quarters*** (given by the points contribution for beer divided by the All groups index). For June, the weight is calculated as 3.04/126.2 x 100 = 2.41 per cent and for September as 3.18/130.9 x 100 = 2.43 per cent. Although the underlying quantities are held fixed, the effective weight in expenditure terms has increased due to the prices of beer increasing by more than the prices of all other items in the CPI basket (on average).

- ***Calculate the percentage increase that would have been observed in the CPI if all prices other than those for beer had remained unchanged*** (given by the points change for beer divided by the All groups index number in the previous period). For September quarter 2000 this is calculated as 0.14/126.2 x 100 = 0.1 per cent. In other words, a 4.8 per cent increase in beer prices in September quarter 2000 would have resulted in an increase in the overall CPI of 0.1 per cent.

- ***Calculate the average percentage change in all other items excluding beer*** (given by subtracting the points contribution for beer from the All groups index in both quarters and then calculating the percentage change between the resulting numbers — which represents the points contribution of the 'other' items). For the above example, the numbers for All groups excluding beer are:
  June, 126.2 - 3.04 = 123.2; September, 130.9 – 3.18 = 127.7; and the percentage change, (127.7 - 123.2)/123.2 x 100 = 3.7 per cent. In other words, prices of all items other than beer increased by 3.7 per cent on average between the June and September quarters 2000.

- ***Estimate the effect on the All groups CPI of a forecast change in the prices of one of the items*** (given by applying the forecast percentage change to the items points contribution and expressing the result as a percentage of the All groups index number). For example, if prices of beer were forecast to increase by 25 per cent in December quarter 2000, then the points change for beer would be 3.18 x 0.25 = 0.8, which would deliver an increase in the All groups index of 0.8/130.9 x 100 = 0.6 per cent. In other words, a 25 per cent increase in beer prices in December quarter 2000 would have the effect of increasing the CPI by 0.6 per cent. Another way commonly used to express this impact is 'beer would contribute 0.6 percentage points to the change in the All groups CPI'.

10.12 To ensure consistency in the application of data produced from the CPI, it is necessary for the ABS to adopt a set of consistent rounding conventions or rules for the calculation and presentation of data. The conventions strike a balance between maximising the usefulness of the data for analytical purposes and retaining a sense of the underlying precision of the estimates. These conventions need to be taken into account when using CPI data for analytical or other special purposes.

10.13 Index numbers are always published to a base of 100.0. Index numbers and percentage changes are always published to one decimal place, with the percentage changes being calculated from the rounded index numbers. Points contributions are published to two decimal places, with points contributions change being calculated from the rounded points contributions. Index numbers for periods longer than a single quarter (e.g. for financial years) are calculated as the simple arithmetic average of the relevant rounded quarterly index numbers.

10.14 The following questions and answers illustrate the uses that can be made of the CPI.

10.15 **Question:** *What would $200 in 1990 be worth in September quarter 2000?*

10.16 **Response:** This question is best interpreted as asking 'How much would need to be spent in September quarter 2000 to purchase what could be purchased in 1990 for $200?' As no specific commodity is mentioned, what is required is a measure comparing the general level of prices in September quarter 2000 with the general level of prices in the 1990 calendar year. The All groups CPI would be an appropriate choice.

10.17 Because CPI index numbers are not published for calendar years, two steps are required to answer this question. The first is to derive an index for 1990. The second is to multiply the initial dollar amount by the ratio of the index for September quarter 2000 to the index for 1990.

10.18 The index for 1990 is obtained as the simple arithmetic average of the quarterly indexes for March (100.9), June (102.5), September (103.3) and December (106.0) 1990 — giving 103.2 rounded to one decimal place. The index for September quarter 2000 is 130.9.

10.19 The answer is then given by:
$200 x 130.9/103.2 = $253.68.

10.20 **Question**: *Household Expenditure Survey data shows that average weekly expenditure per household on the purchase of motor vehicles increased from $26.61 in 1993–94 to $42.64 in 1998–99 (i.e. an increase of 60.2 per cent). Does this mean that households, on average, purchased 60.2 per cent more motor vehicles in 1998–99 than they did in 1993–94?*

10.21 **Response:** This is an example of one of the most valuable uses that can be made of price indexes. Often the only viable method of collecting and presenting information about economic activity is in the form of expenditure or income in monetary units (e.g. dollars). While monetary aggregates are useful in their own right, economists and other analysts are frequently concerned with questions related to volumes, for example, whether more goods and services have been produced in one period compared to another period. Comparison of monetary aggregates alone is not sufficient for this purpose as dollar values can change from one period to another due to either changes in quantities or changes in prices (most often a combination).

10.22 To illustrate this, consider a simple example of expenditure on oranges in two periods. The product of the quantity and the price gives the expenditure in any period. Suppose that in the first period 10 oranges were purchased at a price of $1.00 each and in the second period 15 oranges were purchased at a price of $1.50 each. Expenditure in period one would be $10.00 and in period two $22.50. Expenditure has increased by 125 per cent, yet the volume (number of oranges) has only increased by 50 per cent with the difference being accounted for by a price increase of 50 per cent. In this example all the price and quantity data are known, so volumes can be compared directly. Similarly, if prices and expenditures are known, quantities can be derived.

10.23 But what if the actual prices and quantities are not known? If expenditures are known and a price index for oranges is available, the index numbers for the two periods can be used *as if they were prices* to adjust the expenditure for one period to remove the effect of the price change. If the price index for oranges were equal to 100.0 in the first period, the index for the second period would equal 150.0. Dividing expenditure in the second period by the index number for the second period and multiplying this result by the index number for the first period provides an estimate of the expenditure that would have been observed in the second period had the prices remained as they were in the first period. This can easily be demonstrated by reference to the oranges example:

$22.50/150.0 x 100.0 = $15.00 = 15 x $1.00

10.24 So, without ever knowing the actual volumes (quantities) in the two periods, the adjusted second period expenditure ($15.00), can be compared with the expenditure in the first period ($10.00) to derive a measure of the proportional change in volumes — $15/$10 = 1.50, which equals the ratio obtained directly from the comparison of the known volumes.

10.25 We now return to the question on expenditure on motor vehicles recorded in the HES in 1993–94 and 1998–99. As the HES data relates to the average expenditure of Australian households, the ideal price index would be one that covers the retail prices of motor vehicles for Australia as a whole. The price index that comes closest to meeting this ideal is the index for the Motor vehicles expenditure class of the CPI for the weighted average of the eight capital cities. The Motor vehicles index number for 1993–94 is 113.6 and for 1998–99 it is 105.9. Using these index numbers, recorded expenditure in 1998–99 ($42.64) can be adjusted to 1993–94 prices as follows:

$42.64/105.9 x 113.6 =$45.74

10.26 The adjusted 1998–99 expenditure of $45.74 can then be compared to the expenditure recorded in 1993–94 ($26.61) to deliver an estimate of the change in volumes. This indicates a volume increase of 71.9 per cent.

10.27 **Question***: What would be the impact of a 10 per cent increase in petrol prices on the All groups CPI in the December quarter 2000?*

10.28 **Response:** Two pieces of information are required to answer this question; the All groups index number for September quarter 2000 (130.9), and the September quarter 2000 points contribution for Automotive fuel (5.93).

10.29 An increase in petrol prices of 10 per cent would increase Automotive fuel points contribution by 5.93 x 0.1 = 0.59 index points which would result in an All groups index number of 131.5, an increase of 0.5 per cent.

Constructing special index series

10.30 Although the ABS produces a wide range of indexes from the CPI, there may be occasions when none of those series particularly suit a user's requirement. In this case the user may wish to construct their own index series based on component indexes of the CPI. For example, suppose a researcher was interested in how petrol prices had moved relative to the price of all other consumer goods and services since 1987. As the All groups CPI includes Automotive fuel, it is not quite the ideal measure for comparison purposes, so the researcher wishes to compile an All groups CPI excluding the automotive fuel index.

10.31 The index can be compiled directly by using index points contributions (see examples above) and then indexing the points contributions to 1989–90 =100.0. However, index points contributions are not typically published or available as a historical series, so it is necessary to work with the published index numbers. Also, for CPI components that have a small weight, the use of index numbers can be more precise.

10.32 In constructing a series of this type allowance should be made for the change in weights with each CPI series. Relevant data and weights from the CPI series are shown in table 10.2.

10.33 Now since the CPI is a 'fixed weight index',

$$I_{Ag} = w_{Af} I_{Af} + w_{Ag-Af} I_{Ag-Af}$$

where I is index, w is weight (expressed as a proportion) and in the subscripts *Ag* is All groups, *Af* is Automotive fuel. Noting $w_{Ag-Af} = 1 - w_{Af}$ the desired index number can be estimated as:

$$I_{Ag-Af} = \frac{I_{Ag} - w_{Af} I_{Af}}{1 - w_{Af}}$$

10.34 When the 11th series CPI was introduced in respect of the December quarter 1986, Automotive fuel had a weight of 4.79 per cent and the All groups CPI was 79.8. Thus the index for All groups excluding Automotive fuel is calculated as 79.3 for that quarter. The fuel weight is held at 4.79 per cent until the June quarter 1992 when the 12th series CPI was introduced. The All groups excluding automotive fuel index is calculated for the June quarter 1992 using both 11th series and 12th series CPI weights. This allows calculation of a link factor given by

$$\text{Link factor} = \frac{\text{Index calculated using 11th series weight}}{\text{Index calculated using 12th series weight}}$$

10.35 The link factor is then applied to the index numbers calculated using the 12th series weights. In this case the link factor is 1.0. However, depending on the series being constructed, this may not always be the case.

TABLE 10.2: INDEX VALUES AND WEIGHTS FOR LINKING EXAMPLE

	CPI Published Indexes 8 capital cities		*Weight (link quarter)*	*11th series*	*12th series*	*13th series*	*Link factor*	*Composite index*
	ALL GROUPS	Automotive fuel	Automotive fuel					
Dec 1986	79.8	90.4	4.79	79.3				79.3
Mar 1987	81.4	92.3		80.9				80.9
Jun 1987	82.6	89.6		82.2				82.2
Sep 1987	84.0	89.1		83.7				83.7
Dec 1987	85.5	92.8		85.1				85.1
Mar 1988	87.0	93.3		86.7				86.7
Jun 1988	88.5	87.6		88.5				88.5
Sep 1988	90.2	87.1		90.4				90.4
Dec 1988	92.0	85.0		92.4				92.4
Mar 1989	92.9	85.0		93.3				93.3
Jun 1989	95.2	92.1		95.4				95.4
Sep 1989	97.4	93.5		97.6				97.6
Dec 1989	99.2	97.9		99.3				99.3
Mar 1990	100.9	104.2		100.7				100.7
Jun 1990	102.5	104.3		102.4				102.4
Sep 1990	103.3	109.8		103.0				103.0
Dec 1990	106.0	132.7		104.7				104.7
Mar 1991	105.8	112.2		105.5				105.5
Jun 1991	106.0	106.0		106.0				106.0
Sep 1991	106.6	111.9		106.3				106.3
Dec 1991	107.6	111.5		107.4				107.4
Mar 1992	107.6	110.1		107.5				107.5
Jun 1992	107.3	110.6	4.70	107.1	107.1		1.0000	107.1
Sep 1992	107.4	115.3			107.0			107.0
Dec 1992	107.9	114.7			107.6			107.6
Mar 1993	108.9	110.9			108.8			108.8
Jun 1993	109.3	112.0			109.2			109.2
Sep 1993	109.8	112.2			109.7			109.7
Dec 1993	110.0	113.1			109.8			109.8
Mar 1994	110.4	108.3			110.5			110.5
Jun 1994	111.2	113.5			111.1			111.1
Sep 1994	111.9	114.2			111.8			111.8
Dec 1994	112.8	111.5			112.9			112.9
Mar 1995	114.7	113.7			114.7			114.7
Jun 1995	116.2	115.7			116.2			116.2
Sep 1995	117.6	120.0			117.5			117.5
Dec 1995	118.5	118.3			118.5			118.5
Mar 1996	119.0	117.7			119.1			119.1
Jun 1996	119.8	121.3			119.7			119.7
Sep 1996	120.1	118.8			120.2			120.2
Dec 1996	120.3	122.0			120.2			120.2
Mar 1997	120.5	123.9			120.3			120.3
Jun 1997	120.2	121.9			120.1			120.1
Sep 1997	119.7	120.9			119.6			119.6
Dec 1997	120.0	122.3			119.9			119.9
Mar 1998	120.3	117.0			120.5			120.5
Jun 1998	121.0	118.0	4.04		121.1	121.1	1.0000	121.1
Sep 1998	121.3	115.4				121.5		121.5
Dec 1998	121.9	113.7				122.2		122.2

Note: Base period of all indexes 1989–90 = 100.0.

Handling changes in the reference base

10.36 The pricing reference base is the period of time in which all index numbers in the CPI have a value of 100.0 (with the possible exception of any items that have been newly introduced into the CPI since the pricing reference base period). The pricing reference base of the CPI is changed at infrequent intervals. Since the March quarter 1992 the CPI has used a pricing reference base of 1989–90=100.0. In the June quarter 1982 the reference base was changed from 1966–67=100.0 to 1980–81=100.0. The ABS has produced historical index numbers on the current base, so, normally, there is no need for users to do their own calculations.

10.37 The conversion of an index series from one pricing base to another involves calculating the ratio of the index numbers for the base period from the two series and applying this to the index numbers. For example, consider converting the Clothing group index for Perth from a base of 1980-81=100.0 to 1989–90=100.0 (refer to Table 10.3 for the data). The index number for the group for 1989–90 on a reference base of 1980–81 was 185.6 (rounded to one decimal place). Thus the conversion factor is 0.5388 (100.0/185.6) so that the March quarter 1989 index number on a base of 1989–90=100.0 is 95.4 (177.0×0.5388).

TABLE 10.3 : CONVERTING REFERENCE BASES, PERTH CLOTHING GROUP

	Base 1980–81=100.0	Base 1989–90=100.0
Mar 1989	177.0	95.4
Jun 1989	182.7	98.4
Sep 1989	181.5	97.8
Dec 1989	186.4	100.4
Mar 1990	185.8	100.1
Jun 1990	188.6	101.6
1989–90	***185.6***	***100.0***
Sep 1990	189.2	101.9
Dec 1990	194.1	104.6
Mar 1991	195.3	105.2
Jun 1991	196.5	105.9
Sep 1991	197.1	106.2
Dec 1991	199.5	107.5

Conversion factor
1980–81 base to 1989–90 base = 100.0/185.6 = 0.5388

10.38 Similar procedures are applied to convert the current index base to a 1980-81 bases. For example, the September quarter 1998 index for the Clothing group for Perth was 105.5 which, when multiplied by the conversion factor of 1.856 (185.6/100.0), gives an index number of 195.8 on the reference base of 1980–81=100.0. It should be noted that a different conversion factor will apply for each index and city, that is, the factor for the Clothing group for Perth will differ from the factor for Automotive fuel for Perth and for the Clothing group for Hobart.

10.39 The process of 're-referencing'[70] the reference base should not be confused with the practice of rebasing. Re-referencing is simply dividing the index series by the index number for any period that is desired to be the new base – it does not change the relative movements between periods. On the other hand, rebasing involves introducing new weights, putting every component index in the index structure on a base of 100.0 and recalculating the aggregate index for each period. This will affect the relative movements between periods.

PRACTICAL CONSIDERATIONS

Use of the CPI in contracts and formal arrangements

10.40 The CPI All groups index or lower level component indexes are extensively used in contracts. It is important that parties to a contract seeking to include indexation arrangements have a clear understanding of:

- their objective in indexing the contract
- the nature of the CPI, particularly as to whether it is the most appropriate index to use.

[70] For an example see Allen (1974), p. 27–30.

10.41 Briefly, there may be various objectives in indexing a contract. From the perspective of a service provider or producer (e.g. a landlord), these include the following:

- to maintain the 'real' value of the net income (i.e. to compensate for changes in costs)
- to maintain the 'real' value of the gross income
- to adjust prices in line with movements in market prices of similar items.

10.42 Users should consider carefully whether the CPI is appropriate for their objective (see Chapter 5). In particular it should be noted that the CPI measures price change for purchases of goods and services by households. For example a freight company considering the use of the Transportation index from the CPI to adjust freight contracts for cost movements should consider how relevant changes in petrol, motor car purchase and public transport fares are likely to be as a measure of the change in their costs. It may be that other indexes produced by the ABS are more appropriate.

10.43 The CPI measures what has happened to prices as a result of the interaction of demand and supply forces where the prices are those paid by all households on average in the respective quarter. Current market conditions may be different to what existed over the previous year (assuming annual indexation). For example, the rent index measures rents paid by all households, not just new lettings. If the rental market has gone from an undersupply to an oversupply situation then the appropriateness of indexing to last year's rent increase should be carefully considered. Similarly, the regional dimension may be important for some items. For example, if demand/supply balance in the local rental market is substantially different from that in other capital cities, then how appropriate would it be to index rent to the weighted average rent index for the eight capital cities?

Referencing the CPI in contracts

10.44 If it is determined that the 14th series CPI meets the necessary requirements for use in a contract or formal arrangement, then there are several points which should be considered when wording the arrangement:

- the precise title of the index to be used should be clearly defined. For example, 'the All groups CPI (weighted average of eight capital cities)', or 'the Food group of the CPI (Sydney)'. Ideally the title of the ABS publication from which the index is to be drawn should also be included, such as *Consumer Price Index, Australia* (cat. no. 6401.0)
- the reference period from which changes in the CPI (or its components) are to be measured should be clearly specified. For example, for annual changes it might be the rate of change between 'September quarter 1997 and September quarter 1998'
- the type of change that will be examined should be spelt out, that is whether it is a change in index numbers, percentages, points contribution to total CPI, etc. Often changes in index points and percentages may coincide, or be very similar, so taking this step will help eliminate any confusion
- the method for handling any changes in the series that may occur due to reviews of the index structure and coverage should be specified. For example, as a matter of course the ABS conducts CPI reviews approximately every five years. These reviews can result in major changes to the index purpose, structure, and basket composition among other things. Such changes must be taken into account when incorporating the CPI into any formal arrangement.

10.45 The final decision for determining the appropriateness or otherwise of the CPI, or any of its components, for any particular application lies with the end user. While the ABS can provide technical and statistical guidance, it does not provide advice on indexation practices, nor can it tell users which index would best suit any particular use.

The CPI as a series of indexes

10.46 Users of the CPI will note that, although the All groups index extends back to 1948, this is not the case with many of the component indexes. While this may at times create difficulties for users, it is not practical for the ABS to provide historical series for all items in the structure of the current CPI series. Where historical data are not available for a specific index component and there is need for such a series, users may be able to link to (or apply movements from) a higher level component or another component that is expected to have shown a similar price history.

10.47 As detailed in Chapters 3 and 5, the CPI item weights are updated periodically to ensure that they represent recent consumption patterns of the reference population. The ABS holds such reviews at roughly five-yearly intervals, with the timing generally linked to the availability of results from the household expenditure survey (HES).

10.48 In addition, the reviews may consider whether changes should be made to the structure of the CPI to reflect changes in expenditure patterns, the emergence of new goods and services and/or the decline of other goods and services. This may result in new expenditure classes being created in the regimen, the merging of previous expenditure classes or the abolition of some expenditure classes. There may also be changes in the subgroup and group structures of the CPI.

10.49 Whenever there are changes to the CPI structure, as far as practical the new structure is linked to the previous structure to form continuous index series (see Chapter 3).

10.50 However, on some occasions the changes to the structure may be so significant that it is not possible to create links for every regimen item. For example a new expenditure class may have no equivalent in the previous series in terms of the goods and services included in the item or it is not possible to disaggregate a previous series to enable a satisfactory link to be established. In such cases there is no alternative to discontinuing the old index item and introducing the new group index series without any link. Such a new series does not usually extend back very far, so it is necessary to publish figures for such indexes on a different (later) reference base.

OTHER PRICE INDEXES PRODUCED BY ABS

10.51 The CPI is only one type of price index that is available from the ABS. The following is a brief description of the other indexes.

National accounts price indexes

10.52 The Australian national accounts data includes implicit price deflators and chain price indexes.[71] These indexes are constructed from a wide range of price data, including indexes from the CPI.

[71] For further information, refer to Chapter 10 of *Australian System of National Accounts: Concepts, Sources and Methods 2000* (cat. no. 5216.0) and *Information Paper: Introduction of Chain Volume Measures in the Australian National Accounts* (cat. no. 5248.0).

10.53 Implicit price deflators are derived by dividing a value by its corresponding volume estimate. These only provide an estimate of 'pure' price change between a base year and a later period using the weights of the latter period. These weights will change each period, so a change in an implicit price deflator between any two periods, neither of which is the base period, will reflect changes in both prices and quantities.

10.54 The chain price indexes provide estimates of pure price change. They are annually reweighted chain Laspeyres price indexes. These indexes encompass the whole of the economy. The chain price index most akin to the CPI is the index for household final consumption expenditure (HFCE) The main differences between the chain index for HFCE and the CPI include:

- The chain index is reweighted annually.
- HFCE is broader in scope, encompassing all expenditure by all resident households and non-profit institutions serving households. For example HFCE includes estimates of expenditure on financial services and gambling, neither of which is included in the CPI.
- The national accounts concept and measurement of HFCE differs from the CPI. For example, the HFCE imputes rental payments for owner occupiers.

Producer price indexes

10.55 The ABS publishes a range of producer price indexes for the supply of commodities to the Australian economy for industry sectors and in a 'stage of production' framework.[72] Producer price indexes conventionally relate to the output of domestic industries, at basic prices,[73] either inclusive or exclusive of exports. The indexes are available by commodity group (including major services) with splits for domestically produced and imported commodities, and consumer and capital goods.

10.56 Three stages of production are identified, 'Preliminary', 'Intermediate' and 'Final'. The Final (Stage 3) consumer index is closest to the CPI, but there are major differences:

- the pricing basis for the Final (Stage 3) consumer index is basic prices which means it excludes taxes on products, such as the GST, and any transport and trade margins
- currently the Final (Stage 3) consumer index mainly measures changes in the prices of goods with limited coverage of the service industries and the construction industry
- the weights for the Final (Stage 3) consumer index are based on the 1996–97 Input-Output tables.

USING THE 14th SERIES CPI

10.57 In determining uses for the CPI, close examination of the principal purpose, conceptual approach, basket and population coverage is the starting point. Knowledge of its construction methodology is also valuable in providing insights into its relevance to the purpose at hand. This manual provides details of each of these aspects in Chapters 3, 4, 5 and 7.

[72] Refer *Producer Price Indexes, Australia* (cat. no. 6427.0).

[73] The basic price is the amount received by the producer before the imposition of indirect taxes (less subsidies) on products and transport and trade margins; that is, the ex-plant price.

10.58 To begin with, the principal purpose of the CPI forms the basis on which the index is developed. This purpose should broadly bear some similarity with the use being considered. In the Australian CPI, where measuring price inflation is the principal purpose, users who require cost of living or purchasing power type measures should be extremely careful in adopting the index. These purposes may best be met through the use of carefully selected components of the CPI, special series developed by the ABS from low level price data, or the use of other price indexes such as the producer price index (PPI) series.

10.59 The conceptual approach behind the index may be incompatible with the use being contemplated. To meet the principal purpose outlined earlier, the Australian CPI is constructed on an acquisitions basis, and as such, will only include those items that are acquired by the reference population in the base period. All other types of payments and purchases that do not involve the consumers' acquisition of a good or service are excluded from the basket. This includes a portion of the interest charges incurred through any credit arrangements, any payments made on goods or services acquired in earlier periods, and the effects of certain subsidies and taxes.

10.60 The item and population coverage of the CPI, which is determined largely by the principal purpose and conceptual approach, are equally important to the use of the index in several respects. The population coverage defines a subset of the population to which the CPI directly relates. The consumption pattern of this population helps to provide the index with its item coverage (basket), and the relative importance (weights) of items within this basket. Should the use to which the CPI is being put entail a different population coverage, then the user must make the bold assumption that both groups have very similar consumption patterns and price experiences.

10.61 For example, using the All groups Australian CPI in applications relating to the age pensioner sub-population implicitly assumes that age pensioners make roughly the same types of purchases, and in the same proportions, as all Australian consumer households on average. Furthermore, there is the assumption that the price changes that age pensioners face are the same as those experienced by all other households, on average. Both these assumptions can be seen to be somewhat tenuous.

10.62 The ABS produces a set of annual price indexes, on an outlays basis, for four population subgroups to minimise the impact of these assumptions to the extent possible. These indexes are published annually in *Australian Economic Indicators* (cat. no. 1350.0). The four population subgroups for which the indexes are produced are

- employees
- age pensioners
- self-funded retirees
- other government transfer payment recipients.

To whom does the CPI relate?

10.63 The Australian CPI is designed to measure changes in retail prices experienced by all metropolitan private households in aggregate. The CPI basket and its weights relate to this population as a whole. The index becomes much less representative at successively lower levels of aggregation of this population. Ultimately, the composition and weighting pattern of the basket will not coincide with that of any individual household in Australia. There are several reasons for this.

10.64 First, the basket represents the *average expenditure of all households*, rather than the *expenditure of the average household*. Individual households may have significantly higher or lower expenditure on particular items than the average would suggest.

10.65 Second, the CPI does not measure changes in living costs that may be experienced by individual households as a direct consequence of their progression through the life cycle. For example, younger households may incur a higher proportion of their expenditure on housing and child care, while those households in the older age groups may incur increasing expenditure on medical services. However, changes in the demographic make-up of households does affect the pattern of total household expenditure recorded in the HES and is thus incorporated in the CPI weights during reviews.

10.66 Third, the CPI basket includes items that are mutually exclusive for individual households. For example, both the rent payments of renter households, and the amounts paid by owner-occupier households for purchasing their principal residence are in the basket. No single household will incur both these expenses on their principal residence at the same time.

10.67 Last, although the Australian CPI coverage is extremely broad, it excludes certain households, such as hotels, university residences, and jails, due to the significant differences in their consumption patterns. Individuals in such households may find that the CPI is unrepresentative of their price experiences.

APPENDIX WEIGHTING PATTERN FOR THE CPI – JUNE QUARTER 2000

WEIGHTING PATTERN, 14th SERIES CPI, JUNE QUARTER 2000, EIGHT CAPITAL CITIES

		Percentage contribution to the All groups CPI in June quarter 2000		
	Group, subgroup and expenditure class	*Group*	*Subgroup*	*Expenditure class*
1	**FOOD**	17.72		
1.1	**Dairy and related products**		1.51	
1.1.1	Milk			0.81
1.1.2	Cheese			0.35
1.1.3	Ice cream and other dairy products			0.35
1.2	**Bread and cereal products**		2.20	
1.2.1	Bread			0.82
1.2.2	Cakes and biscuits			0.87
1.2.3	Breakfast cereals			0.24
1.2.4	Other cereal products			0.26
1.3	**Meat and seafoods**		2.62	
1.3.1	Beef and veal			0.54
1.3.2	Lamb and mutton			0.26
1.3.3	Pork			0.19
1.3.4	Poultry			0.49
1.3.5	Bacon and ham			0.26
1.3.6	Other fresh and processed meat			0.43
1.3.7	Fish and other seafood			0.44
1.4	**Fruit and vegetables**		2.30	
1.4.1	Fruit			0.96
1.4.2	Vegetables			1.34
1.5	**Non-alcoholic drinks and snack food**		2.48	
1.5.1	Soft drinks, waters and juices			1.30
1.5.2	Snacks and confectionery			1.19
1.6	**Meals out and take away foods**		4.93	
1.6.1	Restaurant meals			2.03
1.6.2	Take away and fast foods			2.89
1.7	**Other food**		1.69	
1.7.1	Eggs			0.12
1.7.2	Jams, honey and sandwich spreads			0.17
1.7.3	Tea, coffee and food drinks			0.32
1.7.4	Food additives and condiments			0.34
1.7.5	Fats and oils			0.21
1.7.6	Food n.e.c.			0.53
2	**ALCOHOL AND TOBACCO**	7.41		
2.1	**Alcoholic drinks**		5.14	
2.1.1	Beer			2.41
2.1.2	Wine			1.71
2.1.3	Spirits			1.03
2.2	**Tobacco**		2.27	
2.2.1	Tobacco			2.27

For footnotes see end of table.

…Continued

		Percentage contribution to the All groups CPI in June quarter 2000		
	Group, subgroup and expenditure class	*Group*	*Subgroup*	*Expenditure class*
3	**CLOTHING AND FOOTWEAR**	5.19		
3.1	**Men's clothing**		0.98	
3.1.1	Men's outerwear			0.82
3.1.2	Men's underwear, nightwear and socks			0.16
3.2	**Women's clothing**		1.80	
3.2.1	Women's outerwear			1.43
3.2.2	Women's underwear, nightwear and hosiery			0.37
3.3	**Children's and infants' clothing**		0.47	
3.3.1	Children's and infants' clothing			0.47
3.4	**Footwear**		0.83	
3.4.1	Men's footwear			0.25
3.4.2	Women's footwear			0.39
3.4.3	Children's footwear			0.19
3.5	**Clothing accessories, supplies and services**		1.10	
3.5.1	Clothing accessories and jewellery			0.62
3.5.2	Fabrics and knitting wool			0.11
3.5.3	Clothing services and shoe repair			0.37
4	**HOUSING**	19.75		
4.1	**Rents**		5.60	
4.1.1	Rents			5.60
4.2	**Utilities**		3.23	
4.2.1	Electricity			1.66
4.2.2	Gas and other household fuels			0.70
4.2.3	Water and sewerage			0.87
4.3	**Other housing**		10.91	
4.3.1	House purchase			7.86
4.3.2	Property rates and charges			1.20
4.3.3	House repairs and maintenance			1.85
5	**HOUSEHOLD FURNISHINGS, SUPPLIES AND SERVICES**	8.09		
5.1	**Furniture and furnishings**		3.58	
5.1.1	Furniture			2.31
5.1.2	Floor and window coverings			0.72
5.1.3	Towels and linen			0.55
5.2	**Household appliances, utensils and tools**		1.98	
5.2.1	Major household appliances			0.87
5.2.2	Small electric household appliances			0.28
5.2.3	Glassware, tableware and household utensils			0.49
5.2.4	Tools			0.34
5.3	**Household supplies**		1.91	
5.3.1	Household cleaning agents			0.43
5.3.2	Other household supplies			1.48
5.4	**Household services**		0.62	
5.4.1	Household services			0.62

For footnotes see end of table.

…Continued

WEIGHTING PATTERN, 14th SERIES CPI, JUNE QUARTER 2000, EIGHT CAPITAL CITIES

		Percentage contribution to the All groups CPI in June quarter 2000		
	Group, subgroup and expenditure class	*Group*	*Subgroup*	*Expenditure class*
6	**HEALTH**	4.69		
6.1	**Health services**		3.55	
6.1.1	Hospital and medical services			2.71
6.1.2	Optical services			0.16
6.1.3	Dental services			0.69
6.2	**Pharmaceuticals**		1.14	
6.2.1	Pharmaceuticals			1.14
7	**TRANSPORTATION**	15.25		
7.1	**Private motoring**		14.40	
7.1.1	Motor vehicles			5.85
7.1.2	Automotive fuel			4.25
7.1.3	Motor vehicle repair and servicing			2.20
7.1.4	Motor vehicle parts and accessories			1.01
7.1.5	Other motoring charges			1.09
7.2	**Urban transport fares**		0.85	
7.2.1	Urban transport fares			0.85
8	**COMMUNICATION**	2.88		
8.1	**Communication**		2.88	
8.1.1	Postal			0.15
8.1.2	Telecommunication			2.73
9	**RECREATION**	12.29		
9.1	**Audio, visual and computing**		2.70	
9.1.1	Audio, visual and computing equipment			1.30
9.1.2	Audio, visual and computing media and services			1.40
9.2	**Books, newspapers and magazines**		1.08	
9.2.1	Books			0.49
9.2.2	Newspapers and magazines			0.59
9.3	**Sport and other recreation**		4.16	
9.3.1	Sports and recreational equipment			0.65
9.3.2	Toys, games and hobbies			0.52
9.3.3	Sports participation			0.81
9.3.4	Pets, pet foods and supplies			0.43
9.3.5	Pet services including veterinary			0.33
9.3.6	Other recreational activities			1.41
9.4	**Holiday travel and accommodation**		4.35	
9.4.1	Domestic holiday travel and accommodation			2.40
9.4.2	Overseas holiday travel and accommodation			1.95
10	**EDUCATION**	2.69		
10.1	**Education**		2.69	
10.1.1	Preschool and primary education			0.50
10.1.2	Secondary education			0.94
10.1.3	Tertiary education			1.25
11	**MISCELLANEOUS**	4.04		
11.1	**Insurance services**		1.46	
11.1.1	Insurance services			1.46
11.2	**Personal care**		2.14	
11.2.1	Hairdressing and personal care services			0.74
11.2.2	Toiletries and personal care products			1.40
11.3	**Child care**		0.44	
11.3.1	Child care			0.44
	ALL GROUPS(a)	**100.00**	**100.00**	**100.00**

(a) Percentages may not add due to rounding

GLOSSARY

ABS	Australian Bureau of Statistics.
Aggregation	The process of combining lower level price indexes to produce higher level indexes.
All groups	Highest level of the CPI, containing all the groups, subgroups and expenditure classes.
APR	Arithmetic mean of price relatives — refer to Chapter 3 for formula.
APRA	Australian Prudential Regulation Authority
COICOP	Classification of Individual Consumption by Purpose. This classification is the basis for the European Union's HICP.
Cost-of-living (index)	A measure of the change in household income required to maintain a constant level of utility.
CPI	Consumer Price Index — a general indicator of the rate of change in prices paid by households for consumer goods and services.
CPI basket	A commonly used term for the goods and services priced for the purpose of compiling the CPI.
CPI population group	The subset of the Australian population to which the CPI specifically relates. For the 14th series CPI this is all metropolitan private households.
Elementary aggregate	The lowest level of commodity classification in the CPI and the only level for which index numbers are constructed by direct reference to price data.
Expenditure class	A group of similar goods or services. The level at which weights are fixed for the life of an index series and the lowest level for which indexes are regularly published. There are 89 expenditure classes in the 14h series CPI.
Expenditure aggregate	The current cost in dollars per year of purchasing the same quantity of goods or services as was purchased in the weighting base period by the CPI population group.
GM	Geometric mean — refer to Chapter 3 for formula.
Group	The first level of disaggregation of the CPI. There are 11 groups in the 14th series CPI.
Goods and Services Tax (GST)	An ad valorem tax applied to supplies (goods and services produced or delivered) by registered suppliers engaged in taxable activity. The GST is effectively only paid by final consumers. The legislated rate of GST is 10%.
HFCE	Household final consumption expenditure.
HEC	Household Expenditure Classification. The classification used to analyse the Household expenditure survey results.
HECS	Higher Education Contributions Scheme.

HICP	Harmonised Indices of Consumer Prices. An index structure devised and used by the European Union.
Household Expenditure Survey (HES)	A sample survey conducted by the ABS to determine the expenditure patterns of private households. Data from the 1998–99 HES were the primary source of information for the expenditure weights for the 14th series CPI.
ILO	International Labour Organization
Indexation	The periodic adjustment of a money value according to changes in a price index.
Inflation (deflation)	A term commonly used to refer to changes in price levels. A rise in prices is called inflation, while a fall is called deflation.
Link factor	A ratio used to join a new index series to an old index series to form a continuous series.
Metropolitan	For purposes of the CPI, 'metropolitan' refers to the six State capital cities, Darwin and Canberra.
PPI	Producer price index.
Price index	A composite measure of the prices of items expressed relative to a defined base period.
Price levels	Actual money values in a particular period of time.
Price movements	Changes in price levels between two or more periods. Movements can be expressed in money values, as price relatives or as percentage changes.
Price relative	A measure of price movements; the ratio of the price level in one period to the price level in another.
Private households	Households living in private dwellings. Private dwellings exclude prisons, non self–care units for the aged, defence establishments, hospitals and other communal dwellings.
Quality Adjustment	The elimination of the effect that changes in the quality or composition of an item have on the price of that item in order to isolate the pure price change.
RAP	Relative of average prices — refer to Chapter 3 for formula.
RBA	Reserve Bank of Australia.
Reference base	The period in which the CPI is given a value of 100.0. The CPI is currently on a reference base of 1989–90.
Regimen	The selected goods and services priced for the purpose of compiling a price index.
Splicing	A technique used to introduce new items or respondents into the index calculations so that the level of the index is not affected.
Subgroup	A collection of related expenditure classes. There are 34 subgroups in the 14th series CPI.
The New Tax System (TNTS)	Package of changes to the taxation and social welfare system including the introduction of GST and the changes to business taxation announced in response to the review of business taxation.

Transaction prices	The prices actually paid by consumers to acquire goods or services.
Utility	Often defined as the satisfaction derived from consumption of a good or service.
Weight	The measure of the relative importance of an item in the index regimen. Weights can be expressed in either quantity or value terms. Value weights are used in the CPI.
Weighting base period	The period to which the fixed quantity weights relate. The weighting base period for the 14th series CPI is 1998–99.

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