



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

The C.P.I.: A Simple Explanation and Some Words of Warning

John W. Longworth and Ted Bos*

Indexation of wages, pensions and tax scales to allow for inflation requires a reliable measure of the rate of inflation. In Australia the Consumer Price Index (C.P.I.) has been the basis of all official indexation. This paper examines both theoretical and practical problems involved in constructing a C.P.I. and the Australian C.P.I. in particular. Alternative indices of the rate of inflation such as a Wholesale Price Index and an Implicit Price Deflator, are also discussed.

In the March quarter of 1975, the Australian Government agreed to the introduction of wage indexation [10]. Subsequently, unemployment benefits, aged pensions and other welfare payments have become subject to indexation. Furthermore, the 1976 federal budget provided for the indexing of income tax scales. In the context of these policy innovations "indexation" means adjusting wages, pensions, and tax scales to take account of changes in the general level of prices or, in more general terms, to allow for inflation. To make these adjustments, a reliable measure of changes in the general level of prices is required. To date the Consumer Price Index (C.P.I.) has been selected as the most appropriate measure available.

This paper is designed to highlight the inherent difficulties in the construction and use of a C.P.I. or any kind of price index. An awareness of these problems is essential before one can progress to considering the merit or otherwise of any specific indexation proposal. The aims of the paper are fourfold: (i) to consider the concept of a C.P.I. and to examine its relationship to the cost-of-living concept; (ii) to review the practical problems in constructing and calculating a C.P.I.; (iii) to examine the current Australian C.P.I. in some detail; and (iv) to investigate some alternative approaches to measuring changes in the general level of prices.

A Consumer Price Index: The Basic Notions

Prices paid by consumers change frequently. Because prices do not all change either by the same proportion or even in the same direction, it is not easy to gauge how the general (or average) level of consumer prices has changed from one time period to the next. Changes in the general level of consumer prices have begun to assume greater importance as more and more people accept these changes as reflecting changes in the cost-of-living. The measurement of

* At the time this paper was prepared the authors were respectively Reader and Research Assistant in Agricultural Economics within the Department of Agriculture at the University of Queensland. Ted Bos is now a post-graduate student in the Department of Economics at Illinois University.

changes in the general level of consumer prices (or cost-of-living) is not a simple matter. The generally accepted approach is to construct an index which (hopefully) moves in direct proportion to changes in the general level of prices.

(a) The essential concept

A Consumer Price Index is a unit free number the value of which at any one time has no meaning except with reference to a previous (or future) value of the index in some previous (or future) time period. These index numbers are allocated an arbitrary starting value (usually 100) in some base period and any subsequent proportionate change in the index is an *estimate* of the proportionate change in the real variable of interest (e.g., the general level of prices). The objective in calculating a consumer price index is to derive a procedure which makes changes in the index good and reliable estimates of changes in the general level of prices (cost-of-living).

(b) Measurement procedures in outline

There are several approaches to the derivation of a consumer price index. (See, for example [11], Chapter 13). However, there are two basic and widely used procedures which are very similar in concept. These two methods have been named after their originators, Laspeyres and Paasche. The construction of both the Laspeyres and the Paasche price indices involve calculating the cost of a given bundle or basket of commodities at different points in time.

The simplest way to describe the Laspeyres index is to examine the following formula for the value of the index at time t .

$$L_t = \frac{\sum_{i=1}^n p_{it} q_{io}}{\sum_{i=1}^n p_{io} q_{io}} \times 100$$

where L_t = value of Laspeyres' index in time period t relative to the value of the index in period o when the index was arbitrarily assigned the value 100;

p_{it} = the price of the i^{th} commodity in period t ;

q_{io} = the quantity of the i^{th} commodity in the basket of goods purchased period o ;

p_{io} = the price of the i^{th} commodity in period o ; and

n = the number of goods in the basket (or regimen) of goods being included in the index.

From the above formula it can be seen that if all of the n goods considered in the index increased in price by 10 per cent between the base period and period t then L_t would take the value of 110. If the price of some goods rose by 10 per cent, while some rose by only 3 per cent and others actually fell in price, then the final value obtained for L_t would depend upon the relative weights attached to these commodities in the formula.

The formula for the Paasche index is very similar namely:

$$P_t = \frac{\sum_{i=1}^n p_{it} q_{it}}{\sum_{i=1}^n p_{io} q_{it}} \times 100$$

where P_t = value of Paasche's index in time period t relative to the value of the index in period o when the index was arbitrarily assigned the value 100;

q_{it} = the quantity of the i^{th} commodity in the basket of goods purchased in period t ; and

p_{it} , p_{io} and n all have the same meaning as for Laspeyres' index.

The only difference between these two indices is that the items and quantities to be included in the basket of goods (regimen of the index) is determined in period o , the base period, for Laspeyres' index, while the Paasche index determines the basket in period t . The Paasche index involves selecting a different basket of goods in every time period and calculating the cost of this basket in that time period and in the base period. On the other hand Laspeyres' index assumes a constant bundle of goods.

Consumer price indices are invariably calculated using Laspeyres' approach (or slight modifications of this procedure) due to the relative ease and speed with which an index for a fixed bundle of goods can be computed using this method. Paasche's index, however, is likely to receive more attention in the future for reasons which will be discussed below in the section on implicit price deflators.

Consumer Price Indices and the Cost-of-Living: Conceptual Problems

In Australia, there is a growing tendency to accept a change in the official Consumer Price Index (C.P.I.) as a cardinal measure of the proportionate change in the cost-of-living. Money incomes are adjusted (deflated) to take account of the change in the C.P.I. and the resulting "real income" is used as a measure of the standard-of-living. If the C.P.I. rises faster than money incomes, it is assumed that there has been a decline in the standard-of-living. Leaving aside the largely non-economic issues which would lead one to question the use of real income as an indicator of standard-of-living, how appropriate is a C.P.I. as a measure of changes in the cost-of-living and hence as a measure of changes in real income?

(a) The problem created by differential price changes

Commonsense suggests and (if we disregard the problem of "money illusion" and assume constant tastes) economic theory confirms that if, for example, all prices were doubled money incomes would have to double to maintain the same level of material satisfaction (real income). Of course as already mentioned the problem is that prices rarely all move by the same proportion in the same direction, even over relatively short time periods. Furthermore, as

differential price changes occur consumers switch their purchases from commodities which have become relatively dearer to relatively cheaper substitutes. Consumer purchasing patterns are, therefore, constantly changing.

As a result of these changes in consumption patterns, a bundle of goods selected to represent a typical shopping basket in the base period will become increasingly atypical as time progresses. Since the Laspeyres' approach adopts a fixed bundle of goods selected in the base period, a simple Laspeyres' consumer price index will overestimate rises in the cost-of-living. The index will give greater weight to the commodities which have become relatively dearer than would be the case in the typical shopping basket after consumers have adjusted to the differential price changes.

The Paasche approach for similar reasons will yield an index which underestimates the increase in the cost-of-living when the general level of prices rises. In this case, the typical shopping basket in the present period is used to determine the weights for the base period. The items which are relatively cheaper now and hence which carry a greater weight in the typical shopping basket, would not have been purchased in the same quantities in the base period when they were relatively dearer. As a result the Paasche procedure overestimates the cost-of-living in the base period and hence underestimates the change between the base period and the present when the cost-of-living is rising.

Clearly, irrespective of which approach one adopts, the passage of time and hence changes in relative prices, will make price indices unreliable estimates of the cost-of-living unless the base period *and* the basket of commodities considered are both changed fairly frequently. The question is how frequently should the authorities make these changes?

In the case of a Paasche type index the bundle of goods or regimen is changed every time the index is calculated but as the current period moves further away in time from the fixed base period, the greater will be the bias in the index. The question, therefore, is whether or not the base period should be altered. This highlights a major problem with Paasche type indices. Consider three values for the index P_0 in the base period (usually 100), P_1 in the next period, and P_2 in the third period. P_1 estimates the proportionate change in the variable of interest between the first and second period. P_2 estimates the proportionate change between period one and period three. Now since P_1 and P_2 have been calculated using different regimens, P_1 and P_2 cannot be meaningfully compared. The usual practical solution to this problem is to construct linked or chained indices. That is, to calculate P_1^* to estimate the change between the first and second period. Then the base is shifted from the first to the second period and P_2^* is calculated to represent the change between the second and third period. It is important to realize that the change indicated by combining P_1^* and P_2^* will not, in general, be the same as that suggested by the value of P_2 . A diagram will help clarify this point.

	Base period fixed as first time period for all calculations	Base period shifting forward one time period each time index is calculated
First time period		
Second time period		
Third time period		

The Laspeyres' type indices, by definition, have a constant regimen while-ever the base period remains fixed. Therefore, if we substitute L for P in the above diagram, we can see that L_1 and L_2 can be directly compared since both have been calculated using the same (first period) regimen. If the base period and hence the regimen is altered to calculate L_1^* and L_2^* (substituting L for P in the right hand column on p. 24), then we cannot, in general, expect L_2 to indicate the same change as indicated by combining L_1^* and L_2^* .

Irrespective of whether one is using a Paasche or Laspeyres type index the question of how frequently to change the base period is a very important one. It will depend, among other things, upon the rate at which the general level of prices is changing. During periods of rapid price change, there will be a greater need to adjust the base period. In the case of the Australian C.P.I., this need for more frequent changes during a period of relatively high rates of inflation has created political problems. It has, for example, been suggested that the procedure used to calculate the index is being altered regularly to ensure the index underestimates the "true" rate of change in the general level of prices.

(b) Other conceptual problems

So far we have implicitly assumed everyone has a similar level of income and similar tastes. If this were the case then everyone would purchase a similar bundle of goods at any given time. Furthermore, everyone would respond to differential price changes in a similar fashion. Obviously, in the real-world people will not have similar incomes and tastes. Under these circumstances it becomes much harder to establish that there is any such thing as a typical bundle of goods. It follows, therefore, that there will be no unique change in the cost-of-living. It may be feasible to consider some average cost-of-living concept, or to speak of changes in the cost-of-living for people on the average income. But it is illusionary to imagine that there is any such thing as "the cost-of-living" except in regard to a single household.

Another major conceptual problem concerns the quality aspect of items included in the basket of goods. Today most items of consumption are available in a wide range of qualities. Furthermore, the quality of many items changes substantially over time. Under these circumstances great care must be taken in defining the individual items to be included in the index to ensure that price changes over time do not incorporate an element due to quality changes. However, it is not uncommon for a better quality (and usually higher priced) article to completely replace an inferior version of the same commodity. Under these circumstances a technique called splicing is employed in an attempt to eliminate from the index that component of the price rise which is due to the quality change [11, pp. 360-364].

(c) Conclusions at the conceptual level

There are many ways to construct a C.P.I. Given a particular formula there is a virtually infinite range of possible regimens to consider. Each index will, therefore, measure something different. There are no good *a priori* reasons for preferring one particular index over another unless we know for what the index is supposed to be a proxy. In theory, changes in the ideal C.P.I. should measure changes in the cost of maintaining a given level of consumer satisfaction. In practice, it is virtually impossible to define or measure aggregate consumer satisfaction and hence it becomes necessary to state precisely what any given index is supposed to measure.

Unfortunately the concept of *the* cost-of-living is illusionary. Therefore, statisticians select *a* cost-of-living, say the cost-of-living of a typical family on an average income, and set out to find a C.P.I. with which to measure changes in this particular concept of cost-of-living.

Great care must be taken to understand what it is that we want to measure (*i.e.* cost-of-living) and what it is the selected C.P.I. does, in fact, measure. Only by being fully aware not only of the conceptual problems but also of the practical problems in defining and calculating a C.P.I., can we fully appreciate the limitations of using any particular C.P.I. to calculate changes in standards-of-living, to index wages, pensions and taxes, or for any other purpose.

Constructing a C.P.I. : Practical Problems

There are many practical problems in constructing a consumer price index. Deciding which items to include in the regimen and what weight each item should be assigned; collecting price data whenever the index is to be evaluated; and seasonal variation in the prices, quantities and qualities of various items are three especially difficult problem areas.

(a) Selecting the basket of goods (regimen)

Perhaps the most important step in constructing a C.P.I. is the selection of the regimen. First one must define and record carefully exactly what the index is intended to measure. While this may appear obvious, it is frequently overlooked especially in the case of an index which has been in use for some time. Most official statisticians are careful to state that their indices do not measure the rate of inflation, or changes in the cost-of-living, but simply changes in the general level of prices for the commodities in the regimen of the index concerned. As already pointed out their caution is justified on conceptual grounds but rarely heeded by politicians and others.

The selection of which items to include in the basket and what quantity weight to attach to each item is usually based on a careful analysis of a target population and its buying habits. The target population is usually defined as a portion of the total population which is representative in some sense. In the United States, for example, the Bureau of Labor Statistics (B.L.S.) defines their C.P.I. as "a statistical measure of changes in prices of goods and services bought by urban wage earners and clerical workers, including families and single persons" [20]. The United States Bureau conducts consumer expenditure surveys to determine the appropriate weights for each item and for the various groups of items in the regimen of their C.P.I.

When the regimen of a C.P.I. is to be based on a consumer expenditure survey the random sampling process will be constrained to ensure that the number of households included in the survey in each area to be covered, is roughly proportional to the number of households in the target population in the area in question. The range of geographic areas to be included will depend upon the intended uses of the C.P.I., the geographic distribution of the target population and the data gathering techniques employed (mail questionnaire or personal observation). Cost considerations may also limit the scope of the survey.

As the name "consumer price index" would imply, a C.P.I. is designed to measure changes in the price level of consumption goods and services. That is, it is concerned with items which are consumed more or less immediately or at

least before the index is recalculated the next time. However, many large items in the cost-of-living are not consumed all at once over a relatively short period of time. Washing machines, television sets, motor vehicles, even clothing, are purchased only at long intervals and they provide a service over relatively long periods of time. These consumer durables need to be included in the basket of a C.P.I. but they present especially important problems with regard to quality changes and the appropriate quantity weight which should be assigned to each. Furthermore, the question of which consumer durables are luxuries and hence should/could be left out of the regimen, is largely a matter of judgment at any particular point in time.

Another especially significant but troublesome item is housing. Most C.P.I. procedures include housing rent but defining exactly what quality of housing is involved is a very difficult matter. As with consumer durables, there will be subtle but important quality changes over time. To separate quality effects from price rises when rents increase is clearly a fairly arbitrary business.

Public goods also present major problems for the construction of a C.P.I. In most countries now-a-days many people consume large amounts of public goods and services free-of-charge or for nominal fees. Of course, the real cost of these goods and services to the community is often substantial. Furthermore, the cost of providing these public goods and services may change substantially over time. Should these items be included in the regimen of a C.P.I.? If so, then what price should be used as an indication of the cost of the item in question? These problems have recently created special difficulties in Australia with the introduction of Medibank. More generally, if public goods are included in the C.P.I. and their price is deemed to be the nominal fee charged by the public sector, then clearly the government can manipulate the C.P.I. by raising or lowering the nominal fees charged for public goods and services.

Much the same problem arises with indirect taxation. If items in the C.P.I. are valued at their market price including, for instance, sales tax; the government can orchestrate changes in the C.P.I. by raising or lowering sales tax. Some countries, Denmark for example, value goods in the C.P.I. regimen exclusive of indirect taxes. While this may appear attractive it must greatly complicate the collection of price data. In addition what about tariffs and home consumption prices and other public policy induced distortions in market prices? Should the C.P.I. be adjusted to eliminate the effects of these policies as well?

One solution to the problems created by the impact of the public sector would be to exclude from the C.P.I. regimen all items the price of which are directly or indirectly influenced by the Government. While this may create a more reliable C.P.I., it certainly would no longer be useful as a proxy for changes in the *general* level of consumer prices much less cost-of-living.

(b) Sampling price data

Once the items to be included in the C.P.I. together with their respective quantity weights, have been chosen, the next practical problem concerns collecting the prices for each of the specified items in the basket at each point in time for which the index is to be evaluated. To do this the responsible authority must define the collection date and specify which shops or other sources are to be sampled for price data.

Specifying a date on which prices are to be recorded may involve problems. Some commodities, for instance fresh fruit and vegetables, can show great price variation from day-to-day. Furthermore this variation may be systematic over the days of the week, being lowest on Monday and highest on Friday, for example.

The price of any one item will be collected from many retail outlets on any given sampling date. As these prices will undoubtedly vary and as only one price for the item is required in the calculation of the C.P.I., some average price must be arrived at for each item. The average price will be calculated by weighting each of the observations according to shopping patterns revealed in the latest consumer expenditure survey. As shopping patterns change over time so must the averaging process be adjusted to take account of these changes. Therefore, not only must the regimen be altered from time-to-time but also the price gathering and averaging process will need to be updated. In this sense changing shopping patterns over time can effect a C.P.I. calculation in much the same way as differential price changes. For instance, suppose an item in the regimen is being valued at a price which is calculated on the assumption only 20 per cent of the commodity in question is purchased in super-markets (at lower prices). If, in fact, due to a substantial shift in shopping habits, consumers now buy 60 per cent of this commodity at lower prices in supermarkets, the weighted average price being used for this item will be too high. As a result the C.P.I. will overestimate the general level of prices for the goods in its regimen.

But the question of changing shopping patterns does not stop there. Although, by switching her purchases from the small corner store to the large super-market, the housewife obtains the benefit of lower prices, it could mean an over-all increase in her cost-of-living when the additional transport costs involved are included. Any given C.P.I. will be unlikely to fully allow for all of these things simultaneously.

There will be items such as household rents and government services which are not priced in shops. To collect this kind of price information while guarding against disguised "quality" changes is a major problem.

Once the date and places are selected, the method used to collect the prices must be chosen. Most official C.P.I. calculations are now based upon direct observation by specially trained fieldworkers. This approach is expensive and it limits greatly the geographic coverage and overall size of the sample of price data. On the other hand the specialist data collectors can minimize the problems caused by quality changes, container size changes, specials, and so on, all of which could seriously distort price information if it was not recorded with great care. The only real alternative to direct observation is to mail questionnaires to sampled shopkeepers. While collecting price information by mail questionnaires is much cheaper and relaxes the geographical limits of the price survey, the accuracy of these data is likely to be suspect for obvious reasons.

(c) Seasonality in prices, quantities and qualities

Official C.P.I.'s are usually calculated every month or at least every quarter. This procedure raises serious problems when the regimen includes goods like ice cream and slippers which are likely to have a strong seasonal pattern in terms of the quantities demanded at any given price. In addition, many kinds of fresh fruit and vegetables may not be available at certain times of the year

or, if they are available on a year-round basis, then they are likely to vary greatly in quality from season-to-season. It would not make much sense to give these seasonally demanded or seasonally available items the same weight in the C.P.I. for all months or quarters.

In principle, therefore, the weight attached to seasonal commodities should vary from period-to-period throughout the year. In Canada, for example, seasonal weights are used for the subgroups within the food group while the food group weight is held constant. The idea is that total expenditure on food remains steady while the food items bought change seasonally.

When the index is calculated using Laspeyres' formula, changing the basket of commodities as the seasons change will make comparing the C.P.I. from one season to the next, rather suspect. On the other hand, comparisons between C.P.I. values for the same season in different years may be more meaningful.

The Australian C.P.I.

The original "C" Series Retail Price Index was first calculated for 1914. Until 1954 the "C" Series was the major Australian retail price index [3, 4 and 11]. Being a Laspeyres type index the regimen and weighting rapidly became out-of-date after World War II due to dramatic changes in both the patterns of expenditure and the range and quality of consumer items available. In 1954 the old "C" Series was supplemented by the Interim Retail Price Index which was first computed for 1950-51. The current Australian Consumer Price Index was first published in 1960. However, a continuous series has been derived for this C.P.I. which extends back to the September Quarter of 1948.

(a) General description

The Consumer Price Index, like its predecessors, is a Laspeyres type index. When initially constructed according to the Commonwealth Statistician, it was designed "to measure quarterly variations in retail prices of goods and services representing a high proportion of the expenditure of wage earner households" [2, p. 7]. The full C.P.I. is published quarterly in the Australian Bureau of Statistics (A.B.S.) publication number 9.1 entitled *Consumer Price Index*. The Food Group Index is calculated monthly and this part of the C.P.I. may be found in A.B.S. publication number 9.11 entitled *Consumer Price Index: Monthly Food Group Index Numbers*.

Apart from the Food Group, the Australian C.P.I. includes four other major groups of commodities: Clothing and Drapery, Housing, Household Supplies and Equipment, and Miscellaneous. Indices for all five groups and for the whole C.P.I. are calculated and published for each capital city, for Canberra and for Australia. The Australian C.P.I. is a weighted average of the C.P.I.'s for each of the six capital cities. The C.P.I. for each capital city is weighted by the proportion of the total population living in all the capitals which actually lives in the city in question.

The Consumer Price Index has been designed as a series of linked indices to allow for updating the regimen and weights. In fact, the continuous series from September quarter, 1948, to the present consists of eight links. Each link is characterized by having a slightly different regimen. Except for the latest link beginning in September quarter, 1976, changes in the weighting

Table 1: *Regimen of Consumer Price Index; Composition as at December Quarter, 1968, for the Six State Capital Cities Combined*

Group, subgroup	Percentage contribution to total index aggregate	
	Subgroup	Group
<i>Food—</i>		31.3
Cereal products	4.1	
Dairy produce	6.0	
Potatoes, onions, preserved fruit and vegetables	2.7	
Soft drinks, ice cream and confectionery	4.3	
Other food (except meat)	3.3	
Meat—Butcher's	8.4	
Processed, including poultry	2.5	
<i>Clothing and drapery—</i>		14.1
Men's clothing	3.6	
Women's clothing	5.0	
Boy's clothing	0.6	
Girl's clothing	0.8	
Piecegoods, etc.	2.5	
Footwear	0.8	
Household drapery	0.8	
<i>Housing—</i>		14.2
Rent—Privately owned houses	2.1	
Privately owned flats	3.1	
Government owned houses	0.9	
Home ownership—House price	3.4	
Rates	2.7	
Repairs and maintenance	2.0	
<i>Household supplies and equipment—</i>		12.5
Fuel and light—Electricity	2.4	
Gas	1.0	
Other (firewood, heating oil, briquettes and kerosene)	0.6	
Household appliances	2.6	
Other household articles—		
Furniture and floor coverings	1.9	
Household and other utensils, gardening and small tools	0.7	
Household sundries (household soaps, etc.)	1.0	
Stationery	0.2	
Personal requisites (toilet soap, cosmetics, etc.)	1.2	
Proprietary medicines	0.9	
<i>Miscellaneous—</i>		27.9
Fares—Train	1.0	
Bus and tram	1.5	
Motoring—Goods	6.4	
Services and charges	2.8	
Cigarettes and tobacco	3.6	
Beer	3.7	
Services—Health (dental, medical, hospital)	3.3	
Hairdressing	0.7	
Drycleaning	0.5	
Shoe repairs	0.2	
Postal and telephone services	1.1	
Cinema admission	0.8	
Other—Radio and television operation	1.1	
Newspapers and magazines	1.2	
Total	100.0	100.0

assigned groups and subgroups in the index were based on the Censuses of Retail Establishments. Changes in the weighting of the six capital cities were based on Censuses of Population. A simplified version of the regimen and weights used in the sixth link (1968–1973) of the C.P.I. is shown in Table 1. For a more complete listing of the regimen see [2, pp. 33–39].

(b) Some other issues

The target population for the first seven links in the C.P.I. appears to have been very broad since the total population in each capital was used as a weighting factor. The latest link has been based on a much more specific target population namely urban families who earn from \$60 to \$370 per week. The regimen and quantity weights for the eighth link are based on a consumer expenditure survey aimed at this target population.

Changes in the target population and in the methods used to select the regimen items and their respective weights, could be equated with a change in the whole meaning of the C.P.I. In this sense the latest link in the Australian C.P.I. has been designed more as an index of the cost-of-living than was the case with the C.P.I. in the past. Historically the Australian C.P.I. was essentially a retail price index.

Prior to the September quarter, 1976, the Australian C.P.I. attempted to avoid seasonality in fresh fruit and vegetable supplies and qualities by including only potatoes and onions in the regimen. This was a serious deficiency in the index. There is no *a priori* or empirical evidence to support the implicit assumption that the prices of potatoes and onions are good proxies for the general level of fresh fruit and vegetable prices. Furthermore, as incomes rise there is a tendency for people to switch from the staple vegetables like potatoes and onions to other dearer but more attractive items. There have been many occasions when price rises in potatoes or onions (or both) have pushed the Food Group Index up dramatically although the change in potato and onion prices did not reflect the general tone of the fresh fruit and vegetable market. In addition, although potatoes and onions are available all-year-round, their prices exhibit a strong seasonal pattern and this must have caused problems in calculating the index. For all these and other reasons, the avoidance of the seasonality problem with fresh fruit and vegetables by leaving them out of the regimen was not a very satisfactory procedure. The new link which began with the September quarter, 1976, does include an item labelled "fresh fruit and vegetables" but details of this innovation have not yet been published.

There is an attempt to allow for seasonality in the demand for clothing in the Australian C.P.I. Summer clothing is not generally available in winter and *vice versa*. To allow for this state of affairs, the clothing group index is a combination of two indices, one for summer clothes and the other for winter clothes. The summer clothes index is only calculated in the September and December quarters while the winter clothes index is derived for the March and June quarters. These two indices are then combined to form one index for clothing.

The derivation of any index and a C.P.I. in particular, involves an elaborate sampling procedure. The resulting statistic(s) are, therefore, subject to a sampling error. The United States Bureau of Labor Statistics publishes standard errors for their estimates of changes in the American C.P.I. There does not appear to be any attempt to present similar data for the Australian C.P.I. However, the lack of a measure of the reliability one can attach to a

statistic like a C.P.I. should not deceive one into regarding the statistic as being error free. The Australian C.P.I. should be viewed not as an exact measure but as a statistical estimate around which one could construct confidence intervals if the standard error of the statistic was made public.

Alternatives to the C.P.I. Concept

At best a C.P.I. can only measure changes in the general level of prices of goods and services consumed by a particular group of people. In this sense a C.P.I. may be the only feasible way to measure changes in the average cost-of-living of the average household in the target population. But inflation is something else altogether. Inflation is reflected in the general level of *all* prices in the economy.

A C.P.I., therefore, is unlikely to provide a good measure of the rate of economy-wide inflation. In most developed economies there are two commonly used alternative measures of inflation about which very little has been heard in Australia. They are Wholesale Price Indices (W.P.I.) and Implicit Price Deflators (I.P.D.). Both, but particularly I.P.D.'s, are more broadly based indicators of the general price level in an economy than a C.P.I.

(a) Wholesale price indices

A W.P.I. is compiled in much the same way as a C.P.I. but, as the name suggests, wholesale prices rather than retail prices are used. In countries like the United States where the target population for the C.P.I. is rather narrow [20], the W.P.I. has been used for a long time as a more reliable indicator of inflationary trends.

The refinements introduced with the latest link in the Australian C.P.I. have made the Australian C.P.I. even less appropriate than in the past as a measure of inflation. Under these circumstances perhaps more attention should be focussed on the Australian W.P.I.

Wholesale prices change ahead of retail prices and for this reason a W.P.I. would be more up-to-date as a measure of the current rate of inflation in the economy than a C.P.I. This is another good reason for preferring the W.P.I. as an indicator of the rate of inflation.

(b) Implicit price deflator

The growing concern about inflation and how to measure it has encouraged attempts to devise measures of the change in the general level of prices which are as broadly based as possible. One alternative which has gained some attention in Australia is derived from official data on the Gross Domestic Product (G.D.P.).

The two relevant data series are "G.D.P. at current prices" and "G.D.P. at 1966-7 prices". An Implicit Price Deflator (I.P.D.) series can then be calculated by dividing G.D.P. at current prices by the corresponding G.D.P. at 1966-7 prices. The I.P.D. in this case will be an index with the value of 1.00 in the base year 1966-7.

The biggest conceptual problem with this approach hinges on how the series "G.D.P. at 1966-7 prices" is derived and what these figures mean. The series "G.D.P. at 1966-7 prices" represent a quantity index which reflects changes

in the general level of physical quantities over time weighted by constant prices. The analogy with a C.P.I. (where it is the quantities which are constant and the index measures changes in the general level of prices) is obvious. As with the calculation of a C.P.I., there are two basic kinds of quantity indices—one according to Laspeyres' formula and a second based on the formula due to Paasche.

A Laspeyres quantity index can be written

$$L_t = \frac{\sum_{i=1}^n p_{io} q_{it}}{\sum_{i=1}^n p_{io} q_{io}}$$

while Paasche's quantity index can be expressed

$$P_t = \frac{\sum_{i=1}^n p_{it} q_{it}}{\sum_{i=1}^n p_{it} q_{ot}}$$

where the symbols in both equations can be interpreted by analogy with the corresponding terms in the C.P.I. definitions outlined above.

Therefore, the series "G.D.P. at 1966-7 prices" is constructed using the numerator of a Laspeyres' quantity index. When an entry in the series "G.D.P. at current prices" is divided by the corresponding entry for G.D.P. at 1966-7 prices, we have

$$\text{I.P.D.}_t = \frac{\sum_{i=1}^n p_{it} q_{it}}{\sum_{i=1}^n p_{io} q_{it}}$$

which is a price index of the Paasche type.

The series "G.D.P. at 1966-7 prices" is current G.D.P. valued at 1966-7 prices. G.D.P. is calculated from all goods and services purchased in the economy during the year. Since the kinds and quantities of goods and services available change over time, compilers of "G.D.P. at 1966-7 prices" are faced with a similar problem to that which causes difficulties in the calculation of a C.P.I.—namely how to allow for quality changes over time.

The approach adopted to calculating "G.D.P. at 1966-7 prices" in Australia has been as follows. First, all goods and services in the current G.D.P. for which 1966-7 prices are available are revalued at these 1966-7 prices. Although the I.P.D. is not officially published, the I.P.D. is calculated for this particular portion of G.D.P. The I.P.D. determined in this manner is then used to estimate 1966-7 prices for those goods and services not actually available in 1966-7. Once a full set of 1966-7 prices has been obtained the final "G.D.P. at 1966-7 prices" for the current year can be calculated.

The procedure just outlined assumes that the average price change for goods and services for which real 1966-7 prices are not available, were exactly the same as the average price change for those goods and services for which actual 1966-7 prices are available. Other methods of approximation are also used (e.g., in the case of buildings partial price data for 1966-7 are available).

The importance of these approximating procedures will increase as time passes and more and more new products appear in the current G.D.P. On the whole, the assumptions built into the derivation of the G.D.P. at 1966-7 prices seem to be greater than those necessary to calculate the C.P.I. even though much more data is used in the "G.D.P. at 1966-7 prices" series.

Both G.D.P. at current prices and G.D.P. at 1966-7 prices are broken down into subgroups such as "personal consumption expenditure" and "gross fixed capital expenditure". These subseries can be used to calculate subindices of the I.P.D. Thus personal consumption expenditure at current prices divided by personal consumption expenditure at 1966-7 prices yields a (Paasche) price index of personal consumption expenditure. There is a temptation to compare this Paasche type sub-index of the I.P.D. with the C.P.I. However, the C.P.I. is essentially a Laspeyres type index and is, therefore, not strictly comparable at all. For this and other reasons the data in Table 2 should be seen as three *alternative* approaches to measuring the rate at which the general level of prices has changed over time. If one calls these changes "inflation", then Table 2 contains three separate measures of the rate of inflation.

Table 2: Annual Data for Three Indices which could be Used to Measure the Rate of Inflation in the Australian Economy 1948-49 to 1975-76
(1966-67 = 100)

Year	C.P.I.	I.P.D. of personal consumption	I.P.D. of gross domestic product
1948-49	44.8	43.2	43.0
1949-50	47.2	46.8	47.0
1950-51	53.8	53.2	59.3
1951-52	65.9	64.1	61.9
1952-53	72.1	69.7	70.7
1953-54	73.5	71.5	72.8
1954-55	74.0	72.7	73.6
1955-56	77.0	75.9	75.6
1956-57	81.5	80.2	80.5
1957-58	82.3	81.3	81.1
1958-59	83.6	82.6	79.9
1959-60	85.7	84.5	83.8
1960-61	89.2	88.2	86.2
1961-62	89.6	88.6	87.1
1962-63	89.8	89.4	88.2
1963-64	90.6	91.0	91.5
1964-65	94.0	94.0	94.0
1965-66	97.4	97.1	96.8
1966-67	100.0	100.0	100.0
1967-68	103.3	103.1	102.8
1968-69	106.0	106.0	106.2
1969-70	109.4	109.8	110.9
1970-71	114.6	116.7	116.9
1971-72	122.4	123.9	125.0
1972-73	129.8	130.7	136.1
1973-74	146.6	145.3	156.0
1974-75	171.1	169.8	183.4
1975-76	193.3	n.a.	n.a.

Final Comment

Price indices such as C.P.I.'s and W.P.I.'s are not the only kind of indices regularly computed. For example, the Bureau of Agricultural Economics publishes indices such as *The Index of the Volume of Agricultural Output* and *The Index of the Volume of Exports of Agricultural Origin*. However, the current inflationary situation has drawn attention to price indices in general, and the C.P.I. in particular. Questions have arisen about: whether changes in the C.P.I. accurately reflect changes in the cost-of-living; whether changes in the C.P.I. measure the rate of inflation; whether the regimen should include this item or that item; whether the Medibank charge should be included in the C.P.I. calculation; and whether indirect taxes should be excluded. These and many other issues have created great public interest in the statistic known as the C.P.I.

The aim of this paper has not been to debate these questions but rather to provide background information by explaining the basic concepts involved in trying to measure changes in the general level of prices. A major objective has been to caution against the uncritical acceptance of the C.P.I. as a measure of changes in the cost-of-living and to draw attention to alternative, potentially more acceptable, indicators of the rate of inflation.

References

- [1] COMMONWEALTH BUREAU OF CENSUS AND STATISTICS, *Australian National Accounts: National Income and Expenditure 1968-69*, Government Printer, Canberra.
- [2] COMMONWEALTH BUREAU OF CENSUS AND STATISTICS, *Labour Report*, No. 58, Government Printer, Canberra, 1973.
- [3] COMMONWEALTH BUREAU OF CENSUS AND STATISTICS, *Prices, Purchasing-Power of Money, Wages, Trade Unions, Unemployment, and General Industrial Conditions*, 1919, Labour and Industrial Branch Report No. 10, McCarron, Bird and Co., Melbourne, Australia, October, 1920.
- [4] COMMONWEALTH BUREAU OF CENSUS AND STATISTICS, *Wages and Prices. A Short Examination of the Accuracy of the Retail Price Index-Number Used in the Adjustment of Wages*, 2nd edition, Government Printer, Canberra, December, 1931.
- [5] COMMONWEALTH TREASURY, *Round-up of Economic Statistics*, No. 50 (March, 1977) and No. 51 (April, 1977), A.G.P.S., Canberra.
- [6] GALATIN, M., "A True Price Index When the Consumer Saves", *American Economic Review*, March, 1973, pp. 185-194.
- [7] HICKS, J. R., "Consumers' Surplus and Index Numbers", *Review of Economic Studies*, Vol. 9, 1942, pp. 126-137.
- [8] HURWITZ, A., "Constants and Compromise in the Consumer Price Index", *Journal of the American Statistical Association*, Vol. 57, 1962, pp. 813-825.
- [9] IOCHI, R., *Measurement of Consumer Price Changes by Income Classes*, Economic Research, Hitotsubashi University, Kinokuniya Book-Store Co. Ltd, 1964.
- [10] JONES, EVAN, "Wage Indexation", *Current Affairs Bulletin*, Vol. 54, No. 1 (June, 1977), pp. 3-11.
- [11] KARMEI, P. H. and M. POLASEK, *Applied Statistics For Economists*, 3rd Edition, Sir Isaac Pitman (Aust.) Pty Ltd, Melbourne, 1970, Chapter XIII.

- [12] NATIONAL BUREAU OF ECONOMIC RESEARCH, New York Price Statistics Review Committee, *The Price Statistics of The Federal Government: Review, Appraisal and Recommendations*, National Bureau of Economic Research Inc., No. 73, General Series, 1961.
- [13] ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, *Inflation: The Present Problem*, OECD, Paris, December, 1970.
- [14] POLLACK, R. A., "Subindexes in The Cost of Living Index", *International Economic Review*, Vol. 16, No. 1 (February, 1975), pp. 135-150.
- [15] RAJAOJA, V., "A Study in The Theory of Demand Functions and Pure Indexes", *Societas Scientiarum Fennica Commentationes Physico, Mathematicae XXI*, Helsinki, 1958.
- [16] RILEY, H. E., "Some Aspects of Seasonality in the Consumer Price Index", *Journal of the American Statistical Association*, Vol. 56, 1961, pp. 27-35.
- [17] SIEGEL, I. H., "What Concepts are Appropriate to Consumer Price Indexes", *Journal of Farm Economics*, Vol. 38, 1956, pp. 361-368.
- [18] TEPPER, L., "BLS Consumers' Price Index and the AMS Index of Prices Paid by Farmers for Family Living—A Juxtaposition", *Journal of Farm Economics*, Vol. 38, 1956, pp. 378-390.
- [19] UNITED STATES DEPARTMENT OF LABOR, *Techniques of Preparing Major BLS Statistical Series*, Bulletin No. 1168, U.S. Government Printing Office, December, 1954.
- [20] UNITED STATES DEPARTMENT OF LABOR, *The Consumer Price Index: A Short Description*, U.S. Government Printing Office, 1964.
- [21] WEBB, L. M., "Discussion: The Need for an Expanded Price Research Program", *Journal of Farm Economics*, Vol. 38, 1956, pp. 390-394.
- [22] WILKERSON, M., "Sampling Error in the Consumer Price Index", *Journal of the American Statistical Association*, Vol. 62, 1967, pp. 899-914.