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The calculation of higher-level indices in the CPI – a practical guide

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Abstract

This is a reference paper to support the 'Higher-level indices workshop' conducted at the United Nations Economic Commission for Europe's (UNECE) Meeting of the Expert Group of Consumer Price Indices from 26 – 28 May 2014 in Geneva, Switzerland. The paper firstly outlines the approach used by many National Statistical Offices (NSOs) to produce their CPI. A focus is on the methods used to combine elementary aggregate indices and the source and use of weights at the higher-levels of the CPI. The paper then outlines some of the weaknesses with this approach to produce the CPI and discusses a number of recent proposals to address these weaknesses. Country practices are included throughout the paper to demonstrate various approaches to the production of the CPI. The paper concludes with a quality assessment framework that provides NSOs with criteria against which to assess developments to their CPI.

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Section 1: Introduction

1. This paper outlines the traditional approach used by many National Statistical Offices (NSOs) to produce the higher-level indices of the Consumer Price Index (CPI). A higher-level index is an index for some expenditure aggregate above the level of an elementary aggregate[1], including the overall CPI itself[2].

2. The focus is on the methods used to combine elementary aggregate indices and the source and use of weights at the higher-levels of the CPI. Section 2 briefly discusses some of the key considerations when deciding on the purpose, the underlying framework and the methods that underpin the production of the CPI. Section 3 contains the bulk of the discussion which is around the traditional approach to producing the CPI, weaknesses in the approach and a number of methodological and weighting proposals to address these weaknesses. Country practices are included throughout the paper to demonstrate various approaches to the production of the CPI. Section 4 presents a quality assessment framework that provides NSOs with criteria against which to assess developments to their CPI.

[1] Elementary aggregates are usually the smallest groups of similar (ideally homogenous) products for which weighting data are available. The products within the elementary aggregate may be expected to exhibit similar price movements.
[2] IMF CPI Manual Paragraph 9.77

Section 2: Producing the CPI

3. The CPI is one of the most important statistics produced by a NSO. The CPI provides a general measure of the rate of change in the prices of consumer goods and services experienced by households. The CPI is used for a variety of purposes, such as in the development and analysis of economic and social policy, the adjustment of wages and pensions and in a variety of contracts. The CPI directly or indirectly affects all households.

4. The challenge for national statistics Offices (NSOs) is fourfold: to identify user needs; to conceptualise user needs in terms of economic theory; to translate the underlying concept into statistical measurement terms following the fundamental principles of price index measurement; and to construct the indices so defined and evaluate them against purpose. [3]

Determining the purpose of the CPI

5. A statistical office must make a number of decisions before a CPI can be compiled. The first decision is to determine the principal purpose of the CPI. This decision is important because the purpose of the CPI influences a number of methodological and conceptual approaches, including at the higher-levels of the CPI. For instance, the Australian Bureau of Statistics (ABS) presents its CPI as a general measure of household inflation and this purpose determines its conceptual basis. The ABS also compiles and publishes a number of analytical living cost indices (ALCIs); pensioner and beneficiary LCI, employee LCI, age pensioner LCI, other government transfer recipient LCI and self-funded retiree LCI. The purpose of these is to provide a measure of the change in the level of out of pocket expenses for these subsets of the general CPI population and, as such, the methods used in their compilation often differs from those of the CPI.

A theoretical framework for the CPI

6. The purpose of the CPI can be linked to the underlying framework on which it is based.

7. The lower-level theoretical framework for CPIs is essentially based on economic theory relating to consumer behaviour. In this respect a distinction can be made between the traditional CPI based on a fixed-weight basket, as being a cost-of-goods index (COGI), and a cost-of-living index (COLI), which measures the change in expenditures a household would have to make in order to maintain a given standard of living or utility.

8. Many references in the plentiful literature on consumer price indices argue that an advantage of a COLI over a COGI is that the former is supported by economic theory (i.e. the behaviour of the individual in the market place), implying that the latter is not. But economic theory can be used to support both a COGI and a COLI, one at a macro-level and one at a micro-level, and both complement one another. Thus:

    - A COGI measures the inflationary pressures in the economy from price developments in the retail sector. It represents one of many sectors, albeit an important one, in the Stage of

[3] UN Practical Guide to Producing Consumer Price Indices

Processing Framework.

- A COLI measures the expenditure required by a household to maintain their standard of living or utility. Putting aside the definition of utility and whether the COLI is unconstrained or constrained, it is an index constructed from the viewpoint of the individual consumer and has its foundation in micro-economics and the theory of individual consumer behaviour. Unlike a COGI, it takes into account the substitutions consumers make when faced by relative changes in prices either between different goods and services or between different outlets and suppliers.[4]

9. A fixed basket index measures the change in the total value of a given basket of goods and services between two time periods[5]. Of relevance here is that the quality and quantity of the products within the basket remain fixed. Fixing the quality in particular is challenging however this is a critical requirement in the compilation of the index regardless of the index purpose.

10. Hence by definition, the fixed basked index holds the quantities (weights) in the two periods constant while the COLI's quantities are allowed to vary.

11. Determining the purpose and the underlying framework for the CPI is not straightforward and should be undertaken in consultation with users. In practice the CPI will be used for a variety of purposes. Of interest is that there are many different forms of the COLI and fixed basket indexes.

12. Many NSOs do not construct their CPI as a COLI. This is because the quantities required for the COLI in at least one of the periods are unlikely to be observable in practice.

13. The following section examines the methods to produce a fixed basket CPI with a focus on the higher-levels of the CPI.

[4] UN Practical Guide to Producing Consumer Price Indices
[5] IMF CPI Manual Paragraph 9.75

Section 3: The Traditional Approach to Producing the CPI

14. The calculation of the CPI at the higher-levels requires two inputs. They are the elementary aggregate indices and the weights. This leads to two important questions (a) how to combine the elementary aggregate indices to produce the higher level indices; and (b) what is the source of higher-level weights and how frequently should they be updated.

(a) Combining the elementary aggregate indices to produce the higher level indices

15. Typically, the higher-level indices of the CPI are calculated as weighted arithmetic averages of the elementary aggregates using weights from some earlier period that remain fixed for a specified period of time.

16. The different uses of a CPI set within the different frameworks determine a number of measurement issues including the choice of index number formula. Most countries state that they use a Laspeyres index or a "Laspeyres-type" index for their national CPI which, in practice, is somewhere along the continuum between a cost-of-goods index (COGI) and a cost-of-living index (COLI).[6] (The underlying framework will similarly influence the choice of elementary aggregate index formulae however this is beyond the scope of this workshop).

17. The most common "Laspeyres-type" index is the Lowe index formula used by NSOs to produce the higher-levels of the CPI.

18. The traditional higher-level index aggregation formula description "Laspeyres-type" lacks precision. An understanding of the three types of reference periods is needed to accurately describe the traditional approaches used to produce the CPI.

    "The *weight reference period* is the period covered by the expenditure statistics used to calculate the weights. Usually, the weight reference period is a year.

    The *price reference period* is the period for which prices are used as denominators in the index calculation.

    The *index reference period* is the period for which the index is set to 100.0[7]"

19. Below are the Laspeyres, Young and Lowe index formulas.

The ratio form of the Laspeyres index formula and its algebraically equivalent price relative form

$$I^{0:t}_{Laspeyres} = \frac{\sum_{i=1}^{n} p_i^t q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \times 100 \qquad \sum_{i=1}^{n} \left(\left(\frac{p_i^t}{p_i^0} \right) \times \frac{p_i^0 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \right) \times 100$$

[6] UN Practical Guide to Producing Consumer Price Indices
[7] IMF CPI manual paragraph 9.81

The ratio form of the Young index formula and its algebraically equivalent price relative form

$$I_{Young}^{0:t} = \frac{\sum_{i=1}^{n} p_i^t q_i^b}{\sum_{i=1}^{n} p_i^0 q_i^b} \times 100 \qquad \sum_{i=1}^{n} \left(\left(\frac{p_i^t}{p_i^0} \right) \times \frac{p_i^0 q_i^b}{\sum_{i=1}^{n} p_i^0 q_i^b} \right) \times 100$$

Where q_i^b refers to quantities from some period prior to period 0

The ratio form of the Lowe index formula and its algebraically equivalent price relative form

$$I_{Lowe}^{0:t} = \frac{\sum_{i=1}^{n} p_i^t q_i^{b^*}}{\sum_{i=1}^{n} p_i^0 q_i^{b^*}} \times 100 \qquad \sum_{i=1}^{n} \left(\left(\frac{p_i^t}{p_i^0} \right) \times \frac{p_i^0 q_i^{b^*}}{\sum_{i=1}^{n} p_i^0 q_i^{b^*}} \right) \times 100$$

Where $q_i^{b^*}$ refers to quantities from some period prior to period 0, price updated to time 0

20. The formulas demonstrate that the Laspeyres index formula is difficult (impossible) to implement in practice due to the requirement for the weight reference and price reference periods to be the same.

21. It is important, nevertheless, for national statistical offices to be able to state publicly what type of index is being calculated in their CPI. A true Laspeyres index uses quantity data which relate to exactly the same period as the price reference period. This is rarely the case. Most statistical offices have a price reference period which is later than the period to which the quantity data (i.e. the weights) relate and the quantity data will span, say, a year rather than a point in time. This is because the main source of weights data is a Household Expenditure Survey (HES) which typically produces usable results a year or more after the end of a survey period which is not a point in time. In these circumstances, either the HES period weights are used without adjustment, or they are price-updated to the price reference period resulting in the Lowe index, which is often referred to as a "Laspeyres-type" index.

22. When the primary target is to compile a CPI that measures the price development of an actual fixed basket of goods and services, as defined during its weight reference period, then the

weights may be price-updated to ensure that this objective is met. The resulting fixed basket, or Lowe, index will provide a good estimate of the price development if consumers do not substitute as a result of changes in relative prices and quantities tend to remain constant. But of course some substitution may occur over the course of this period and this is why it is important to introduce into the index the latest available basket as soon as possible. [8]

23. The Lowe index method is the approach most often used by NSOs to produce the CPI[9].

(b) the source of higher-level weights and the frequency at which they are updated

Household Expenditure Survey (HES)

24. The HES usually forms part of a broader range of social surveys undertaken by the NSO intended to capture information on population demographics. In their own right, these statistics are important indicators of social welfare. They also perform an important supplementary role in many NSOs and that is in the derivation of weights for the upper levels of the CPI; the HES data inform the products and their quantities that make up the CPI fixed basket. The known weaknesses such as under-reporting and respondent error, particularly when the information requested requires some level of historical recall, are well documented and can compromise the quality of the index weights. A further issue that is likely to undermine their usefulness is the frequency with which they are carried out and the timeliness with which the estimates are prepared. In the ABS context for example, the survey is carried out at six-yearly intervals and data are generally available around twelve months after the reference period. The most recent HES, undertaken in 2009/10 provided weights data for inclusion in the CPI from June quarter 2011. The previous 'basket update' occurred in June 2005 and was based on data from the 2003/04 HES.

Household Final (Monetary) Consumption Expenditure

25. The compilation of national accounts (NA) estimates within an NSO will usually be given the highest priority in terms of resources and effort. Household Final Consumption Expenditure (HFCE) estimates are usually compiled as part of the NA suite of statistics. These data are very often based on the HES but, unlike the HES, estimates may be provided on a more frequent basis, annually or quarterly for example. The ABS compiles annual estimates of HFCE by detailed Input-Output Product Classification which are generally available within three years after the reference period. Although these estimates are based on the HES, the ABS carries out regular short term economy wide surveys which provide estimates of, among other things, retail trade and these data are used to support the compilation of the more frequent HFCE estimates.

26. The Harmonised Index of Consumer Prices (the "European CPI") uses HF(M)CE to derive its weights.

27. HF(M)CE is described as being:

[8] UN Practical Guide to Producing Consumer Price Indices

[9] See reference paper 2 'Why 'Lowe' when 'Young' and 'Laspeyres' are available?' for a detailed description of the Laspeyres, Lowe and Young index formulas and the ABS rationale for using the Lowe method.

- by households, irrespective of their nationality or resident status;
- in monetary transactions;
- on the economic territory;
- on goods and services that are used in the direct satisfaction of individual needs or wants;
- in one or both of the time periods being compared.

28. Of importance here is the notion of 'monetary' expenditure. In general, the NA HFCE estimates include elements of imputed expenditures and HF(M)CE is a subset of HFCE that is based only on monetary expenditures.

29. The ABS has recently undertaken a study to assess the impact of compiling an historical CPI based on upper level weights derived from the NA HFCE estimates. The greater frequency of the available data allowed for annual updating of the basket (and annual chain linking of the index). The resulting index was similar to the existing ABS CPI however it did display slightly lower rates of percentage change over time. Full details of the study are presented in *Workshop Reference paper 3 - ABS STUDY INTO THE USE OF HFCE ESTIMATES FOR CPI WEIGHTING PURPOSES.*

HES versus HFCE

30. In the ABS experience, it is pertinent to discuss the use of HES versus HFCE for deriving CPI weights on the basis of frequency alone. This may not be true of other NSOs however; for example the UK has an ongoing household expenditure survey (the Living Costs and Food Survey; LCF) which produces annual results. The UK Retail Prices Index (RPI), which is used for, among other things, the indexation of the return on government securities derives its weights from the LCF. In the UK experience, there appears to be no issue with data frequency so the discussion is focussed on appropriateness. One immediate advantage of using the HES data is the removal of imputed expenditures. If the ABS were to move to deriving CPI weights from the HFCE estimates, imputed expenditures, particularly for ownership of dwellings would be problematic.

31. Additionally, where income inequality exists within a country, in deriving CPI weights from household expenditure data using a plutocratic[10] weighting scheme, it is accepted that households with greater incomes will have greater influence on the index weights; under the assumption that households with relatively greater incomes will have relatively greater household expenditure. A further advantage of deriving weights from the HES is that higher income households can be omitted from the calculation if it is deemed necessary. Returning to the UK RPI, for the derivation of weights, households with incomes in the highest percentiles are omitted from the calculation as are households who gain a significant proportion of their income from pensions and benefits. Omitting these 'highest earners' from the HES data is fairly straightforward. This might not be so straightforward in the case of the HFCE estimates which are generally intended to represent total household expenditure.

[10] A plutocratic weighting scheme derives weights from the aggregate expenditures of all households; in effect the plutocratic method treats the whole population as a single household.

32. The use of HFCE data for deriving CPI weights can however have other advantages over the HES. As stated, HFCE is a key component of the NA estimates and these estimates are often given priority over all else within an NSO; in short, it is more likely that HFCE estimates will be readily available on a consistent basis. Remaining with the NA theme, the opportunity for greater coherence between the NA and the CPI is obvious and this can be enhanced by the use of a consistent classification structure for the presentation of HFCE and the CPI. The European HICP discussed earlier aims to follow the broad principles of the System of National Accounts in its methods and the European model presents both the HF(M)CE estimates and the CPI within the Classification of Individual Consumption by Purpose (COICOP) classification framework. Opportunities exist therefore to bring greater coherence to NSO practises both internally and with the wider statistical community.

Chain-linking

33. The process of updating the CPI basket, at whatever frequency, results in a 'new' index from the point at which the updated basket is introduced. Updating the products and their quantities and continuing to compile the index will almost certainly have an impact on the index level. To avoid this, a common period (known as the 'link' period) is selected and a comparison is made between the index level based on the outgoing and the incoming baskets at this link period. The result of the link period comparison is used to chain-link the index based on the outgoing basket to the index based on the incoming basket and in effect prevents the change in baskets from impacting index levels.

34. See Attachment 1 for a numerical example of the calculation of the CPI at the higher-levels taken from the ILO CPI manual 2004.

Some of the weaknesses with the traditional approach to producing the higher-levels of the CPI

35. An element of higher-level substitution bias[11] is inevitable in the compilation of a fixed basket index and it is generally accepted that the magnitude of the bias is likely to increase with the 'age' of the basket.

36. The ABS carried out a study which attempted to estimate the higher-level substitution bias in the CPI. The study attempted to re-calculate the historical CPI over the period June 2000 to June 2005 using superlative index methods. The study estimated that the CPI had over-estimated inflation at a rate of about 0.2 percentage points per year which results in additional expenditures by the Australian Government on pensions and other benefits. Details of the ABS study including all of the methods used are given in Attachment 2.

37. The results of the ABS analysis are similar to those achieved in a number of similar studies; 1996 Boskin Commission Report, Toward a More Accurate Measure of the Cost of Living[12] based on the United States Bureau of Labour Statistics (BLS) CPI and 'Recalculations of the Danish CPI

[11] Higher level substitution bias is expected to occur when households exhibit cost minimising behaviour; specifically, as their preferences shift from products with relatively higher levels of inflation to products with relatively lower levels of inflation.
[12] http://www.ssa.gov/history/reports/boskinrpt.html/#cpi6

1996 – 2006[13]'.

38. The process of chain-linking is the well-established method for maintaining consistency in the index levels across different baskets over time. It does however have its weaknesses and its criticisms. Chain drift is often cited as a prominent cause of bias in price indices and occurs if a chained index "does not return to unity when prices in the current period return to their levels in the base period". The lack of transitivity; the direct index from *0* to any period *t* is not equivalent to a chain-linked index over the same period if a basket update has occurred between *0* and *t*. (Apart from the trivial case where the basket update results in no change in the products and quantities in the basket.)

39. Maintaining a continuous time series over an extended period of time (often many years or even decades) is obviously seen as an important consideration in the presentation of the CPI. For some users however, the lack of consistency that arises from the index being based on different combinations of products and quantities at different periods of time is perceived as a weakness. This is an obvious trade-off in the desire to maintain a contemporary basket on which to base the index.

Weights – alternatives to the infrequent HES.

40. Alternative sources to the HES for information on household expenditure are not generally abundant and this discussion has presented, in HFCE, what is probably the most appropriate alternative for NSOs that currently rely on the HES to derive their CPI weights.

41. Additional social surveys intended to capture living standards or business surveys dedicated to capturing retail or wholesale revenue information may also be considered. These alternatives rarely provide the level of detail required for CPI weights. They are however, often used to supplement the HES data during basket updates and are useful for shorter term updates between major basket updates where their frequency allows; particularly if the shorter term surveys highlight significant changes in expenditure patterns since the previous basket update.

Plutocratic and democratic weighting schemes.

42. Standard practice within NSOs is to derive index weights for the CPI using a 'plutocratic' scheme, whereby household expenditures on individual products are aggregated and the aggregates used to derive proportional weights. The weakness in this method, as stated earlier, is that the expenditures of the highest earners will have the greatest influence on the weights and, if their expenditures are atypical, which is certainly plausible, they will distort the results. An alternative to the plutocratic method is the democratic method, whereby each individual household's expenditure shares are calculated independently and expenditure shares on similar products are averaged across the whole population of households. This results in all households having equal influence on the weights. Consider the simple case of two products and two households presented below.

[13] Carsten Boldsen Hansen 2007

Product / Household	Expenditure		Household Exp Share		
	A	B	A	B	
X	1	1	0.5	0.5	
Y	1	7	0.125	0.875	
			0.31	0.69	Average
Population Exp Share	0.2	0.8			

43. Let us assume that product 'A' is a 'necessity' and 'B' a 'luxury' and further assume that household 'Y' is a high earner. The derivation of plutocratic weights (lighter blue) obviously sees household Y dominating the weights through its expenditure on the luxury good, whereas the democratic approach (darker blue), in allowing for equal representation of each household, produces a set of weights less widely dispersed. In instances where income inequality is particularly prevalent, a democratic weighting scheme could be deemed more appropriate.

44. If the reduced dispersion when moving from plutocratic to democratic weights is the general case then it is not difficult to argue how this could mitigate the effect of infrequent reweighting of the CPI in terms of its failure to capture substitution between products as relative prices change. This is by no means clear cut however; it depends on a number of assumptions and infrequent basket updating may not be seen as a factor in deciding on the choice of a plutocratic or democratic weighting scheme. The contrived example above is only intended to be indicative and it should be re-stated that the use of democratic weights is more suited to mitigating the effects of income inequality.

Proposals to address the weaknesses of the traditional approach to the CPI

45. In the ABS context, the six-yearly intervals at which the HES is conducted and the subsequent infrequent reweighting of the CPI is considered as the most significant weakness arising from current practises. Investigations into the use of HFCE data as an alternative to the HES for weighting the CPI have been undertaken and should the ABS be able to address the concordance and data challenges identified in its study, it will allow for more frequent updating of the CPI weights.

46. Putting aside the lack of up to date expenditure information with which to weight the CPI, strategies to mitigate upper level substitution bias are limited. A 2012 IMF Working Paper[14] proposes geometric alternatives to the traditional arithmetic Laspeyres-type indexes currently used by most NSOs in the compilation of price indexes. The paper states that the arithmetic versions of the Lowe and the Young indexes have serious shortcomings; *"The Lowe index is principally used for CPI compilation in spite of theory and evidence of severe upward bias"*; and puts forward their geometric counterparts as alternatives for reducing the bias inherent in them.

47. The paper presents empirical results using CPI data from the United States. Comparisons are made between the Tornqvist index and the Geometric Young and Geometric Lowe indexes. The

[14] Post-Laspeyres: The Case for a New Formula for Compiling Consumer Price Indexes Prepared by Paul Armknecht and Mick Silver, 2012.

results find that the Geometric Young index, which is consistent with unitary elasticity of substitution[15], has a downward bias when compared with the Tornqvist. And further, that the Lowe price index is found to have a bias against the superlative index that is several times that of the geometric alternatives.

48. The concluding comments suggest that the arithmetic Young and Lowe indices used at the higher levels of the CPI" *have little justification in theory and practice, something of a major concern for this key economic indicator*". And, *"The Geometric Young is easily explained as a weighted geometric average of price changes, using the survey period expenditure shares as weights. The Geometric Lowe has no meaningful interpretation"*. And a final comment; "*the CPI is a key economic indicator and users would be better served by a real-time measure that more closely tracks a superlative index. It may well be that the public will accept a more complex formula if it can be demonstrated that it works much better"*.

[15] Unitary elasticity of substitution occurs when a change in price levels is accompanied by an inversely proportional change in the quantities purchased.

Section 4: A Quality Assessment Framework

49. The difficulty for many NSOs is to determine whether to implement proposed methodological changes or utilise alternate data sources to compile their CPI. The question that is often asked is 'What is the impact on the quality of the CPI?' This is a difficult question to answer.

50. Among statistical agencies there is no commonly accepted definition of data quality for official statistics. Statistical quality in the past might have been synonymous with accuracy, but today a consensus is emerging that quality is a much wider multidimensional concept. The most commonly accepted way of defining data quality is in terms of the broad notion of 'fitness for purpose'. Fitness for purpose encompasses not only the accuracy and reliability of statistical outputs but also other characteristics, such as relevance and timeliness, that determine how effectively statistical information can be used. While some aspects of quality can be assessed in a more or less objective way, an assessment of the wider concept of fitness for purpose is largely subjective as it also brings to account other factors including user views, the soundness of statistical practices and corporate culture, more generally, within the statistics agency. Quality is not absolute. There are a number of trade-offs in the various aspects of quality that have to be managed in consultation with users. It also has to be seen in the context of what is feasible in practice.

51. There are number of quality frameworks available that have been developed by international and national statistical agencies. Statistics Canada[16] and the European Statistics Code of Practice[17] are two of the frameworks that are available.

52. This paper utilises the Australian Bureau of Statistics (ABS) Data Quality Framework (DQF)[18]. The ABS DQF is comprised of seven dimensions of quality, reflecting a broad and inclusive approach to quality definition and assessment. The seven dimensions of quality are:
    - Institutional Environment;
    - Relevance;
    - Timeliness;
    - Accuracy;
    - Coherence;
    - Interpretability; and
    - Accessibility.

53. All seven dimensions should be included for the purpose of quality assessment and reporting. However, the seven dimensions are not necessarily equally weighted, as the importance of each dimension may vary depending on the data source and context.

54. This paper focuses on three dimensions: timeliness, accuracy and interpretability and apply these dimensions of quality in a consumer price indices context.

[16] http://www.statcan.gc.ca/pub/12-586-x/12-586-x2002001-eng.pdf
[17] http://www.dzs.hr/Eng/international/code_of_practice_en.pdf
[18] ABS, *ABS Data Quality Framework,* May 2009, cat. no. 1520.0, ABS, Canberra.

Accuracy[19]

55. Explicit consideration of the trade-offs between accuracy, cost and timeliness is important during the design stage of the CPI. The coverage of the target population that can be achieved by the data collection strategy should be assessed. Adequate measures have to be in place for ensuring response, following up non-response, and dealing with missing data (e.g., through imputation or adjustment made to the estimates). All stages of collection and processing should be subject to proper consideration of the need for quality assurance processes, including appropriate internal and external consistency checking of data with corresponding correction strategies.

56. The above section '*Proposals to address the weaknesses of the typical approach to the CPI*' discusses more recent approaches to improve the accuracy of the CPI by utilising various index formulas. One of the supporting arguments for these new approaches is that accuracy is improved while other dimensions of quality, namely timeliness, is unaffected.

57. Further research is being conducted by various NSOs into these 'Post Laspeyres' methods to determine their suitability for compiling an official CPI.

Timeliness

58. The desired timeliness of official statistics derives from its main purposes: the period for which the information remain useful depends of the rate of change of the phenomenon being measured, the frequency of measure and the immediacy of the response that users may want to make based on the latest information. In addition to considering these aspects when planning target data release dates, consideration needs to be given to the capability of the organisation to produce the statistics within the given time frame. This capability includes staffing resources, system requirements, and the level of accuracy required of the data. The release of preliminary data followed by revised and final figures is often used a strategy for allowing less accurate data to be available sooner for decision making, with the subsequent release of more complete data occurring at a later stage.

59. Given the importance of the CPI for monetary policy and other economic decision-making, it's important that the CPI is released soon after the reference period. For almost all countries a monthly CPI is produced. Timeliness is therefore a key consideration for price statisticians when considering improvements/changes to the methods and data sources used to compile the CPI.

Interpretability

60. Managing interpretability is primarily concerned with the provision of sufficient information about the statistical measures and processes of data collection. Users need to know what has been measured, how it was measured and how well it was measured. The description of the methodology allows the user to assess whether the methods used were scientific or objective, and the degree of confidence they could have in the results. For meeting specific objectives,

[19] A detailed discussion of a framework for quality assuring price statistics is provided by Neideck in 'A Framework for the Accuracy Dimension of Data Quality for Price Statistics', 2007

using analytical, descriptive or graphical techniques can often add value to help draw out the patterns in the data.

61. CPI compilers and users must be able to interpret the results. Recent proposals put forward by Silver and Armknecht (2012) stated "*the CPI is a key economic indicator and users would be better served by a real-time measure that more closely tracks a superlative index. It may well be that the public will accept a more complex formula if it can be demonstrated that it works much better*".

62. Implementing these proposed methods by NSOs is made more difficult when the proposed methods are complex for compilers to interpret and difficult to explain to users, both from economic and statistical methodology perspectives. This, coupled with traditionally cautious cultures of an NSO, will inevitably result in slow adoption of new CPI methods.

List of Attachments

Attachment 1: CHAINLINKING EXAMPLE

Attachment 2: ESTIMATION OF THE UPPER LEVEL SUBSTITUTION BIAS IN THE ABS CPI

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Attachment 1

CHAINLINKING EXAMPLE

An example of the calculation of a chain index is presented in the Table below. From 1998 to December 2002 the index is calculated with the year 1998 as weight and price reference period. From December 2002 onwards, a new set of weights is introduced. The weights may refer to the year 2000, for example, and may or may not have been price-updated to December 2002. A new fixed weight index series is then calculated with December 2002 as the price reference month. Finally, the new index series is linked onto the old index with 1998 = 100 by multiplication to get a continuous index from 1998 to March 2003. The chained higher-level indices are calculated as:

$$I^{00:t} = I^{1998:Dec02} \sum w_i^{00(Dec02)} I_i^{Dec02:t}$$

Because of the lack of additivity, the overall chain index for March 2003 (129.07), for example, cannot be calculated as the weighted arithmetic mean of the chained higher-level indices G and H using the weights from December 2002. The March 2003 index value is calculated as the product of the December 2002 index (124.9), based on the 1998 weight reference period, and the February 2003 index (103.34), based on the 2000 weight reference period.

			Nov-02	Dec-02		Dec-02	Dec-03	Jan-03	Feb-03
Elementary price indices	Weight 1998				Weight 2000				
		1998=100				December 2002=100			
A	0.2	100	120	121	0.25	100	100	100	102
B	0.25	100	115	117	0.2	100	102	103	104
C	0.15	100	132	133	0.1	100	98	98	97
D	0.1	100	142	143	0.18	100	101	104	104
E	0.3	100	110	124	0.27	100	103	105	106
Total	100	119.75	124.9	100	101.19	102.47	103.34		
Higher-level indices									
G=A+B+C	0.6	100	120.92	122.33	0.55	100	100.36	100.73	101.82
H=D+E	0.4	100	118	128.75	0.45	100	102.2	104.6	105.2
Total	100	119.75	124.9			100	101.19	102.47	103.34
						Chaining of higher level indices			
G=A+B+C	0.6	100	120.92	122.33	0.55	122.33	122.78	123.22	124.56
H=D+E	0.4	100	118	128.75	0.45	128.75	131.58	134.67	135.45
Total	100	119.75	124.9	124.9			126.39	127.99	129.07

Attachment 2

ESTIMATION OF THE UPPER LEVEL SUBSTITUTION BIAS

See appendix 7 in *Outcome of the 16th Series Australian Consumer Price Index Review, Dec 2010*, ABS Cat.no. 6469.0

http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/14BC4357F855B7C0CA2577EE000D7B4B/$File/64690_Dec%202010.pdf