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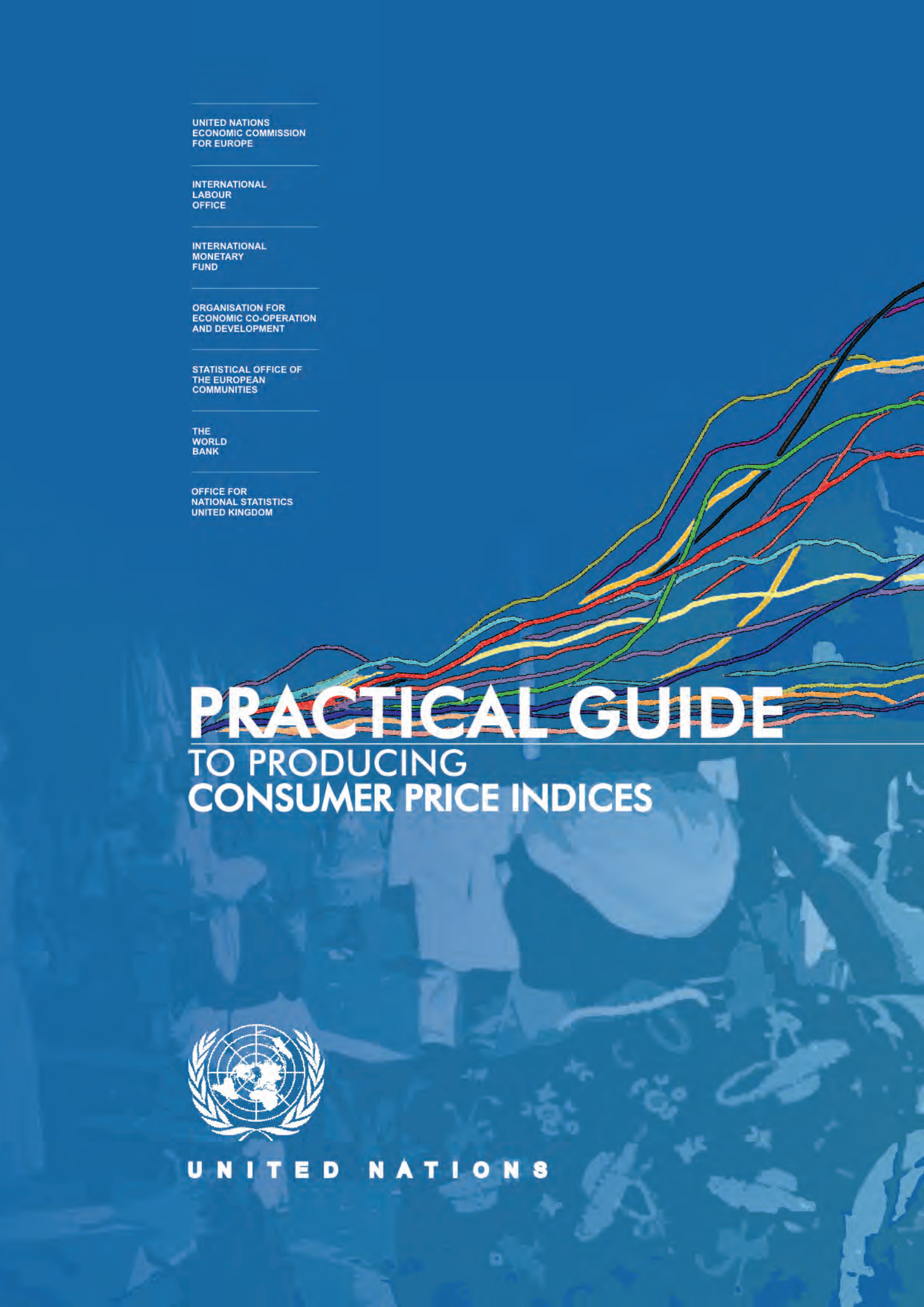

PRACTICAL GUIDE
TO PRODUCING CONSUMER PRICE INDICES

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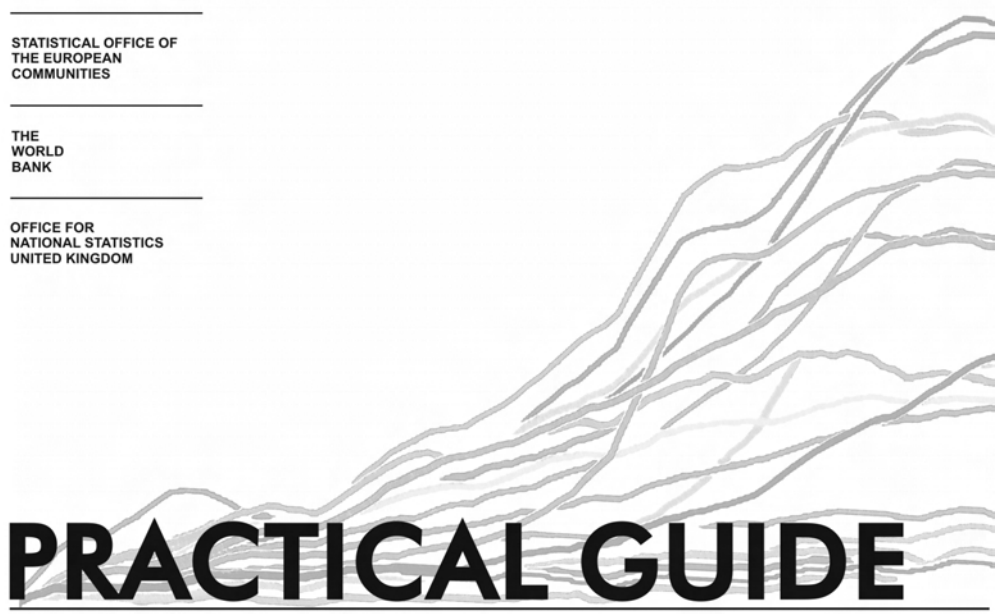

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NOTE

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Foreword

This Handbook is targeted at developing countries focusing on practical solutions to the problems facing compilers of the consumer price index (CPI) in the developing world. It provides practical guidance on all aspects of compiling a CPI, and offers advice on a range of operational issues in data collection, data processing and publication. Although targeted at CPI compilers in developing countries it will also be of interest to compilers more generally.

The Handbook follows and supplements the international *Consumer Price Index Manual. Theory and Practice*, published in 2004. It is accompanied by a CD-ROM with training aids and references, including interactive examples of the methods and calculations given in the Handbook, where users can input their own data.

The publication of the Handbook is the result of a collaborative effort involving experts from a number of countries and organisations, and it has benefited from the input from CPI compilers in developing countries. By referring to the CPI Manual and drawing on experience of experts from both developed and developing countries the Handbook provides internationally agreed guidance and suggests good practices with the objective to help national statistical offices to further improve their CPI statistics.

Preface

Introduction

The production of this Handbook has been funded by the UK Department for International Development under the direction of the UK Office for National Statistics and developed with support from the Inter-Secretariat Working Group on Price Statistics. It is designed to give practical guidance on the compilation of consumer price indices (CPIs), focusing on practical solutions to issues facing the compilers of CPIs in the developing world. It offers advice on a whole range of operational issues confronted by index compilers from the sampling and collection of prices through to index construction and final publication. Although targeted at compilers of CPIs in developing countries it will also be of practical use to compilers of CPIs in other countries.

This Handbook supplements the ILO Manual on Consumer Price Indices. The latter provides a comprehensive review of the economic and statistical theory which underlies CPIs, as well as an in-depth guide to compilation, and has been written for the benefit of users as well as producers. In contrast, the Handbook takes the underlying theory as given. Cross-references to the ILO Manual are provided for those who wish to investigate the more theoretical aspects. Users of this Handbook are encouraged to take advantage of this as it is important to understanding the conceptual and theoretical context underlying the practical advice being given.

The Handbook is also accompanied by a set of PowerPoint slides for local training purposes and a CD-ROM with interactive examples of the illustrative calculations given in the Handbook, where users can input their own data.

Background

In 2004 a comprehensive *Consumer Price Index Manual: Theory and practice* was published by the International Labour Office (ILO), with the support and co-operation of a number of other international organisations. It is an expanded revision of the earlier ILO publication *Consumer price indices: an ILO manual*, published in 1989. The new Manual is widely regarded as the main international reference source for CPIs. It covers virtually every aspect of a consumer price index. Yet some CPI practitioners, especially in developing countries, have found that its comprehensiveness has made it less suitable as a day-to-day source of guidance, particularly on detailed practical issues. This Handbook, which is a companion volume to the Manual, focuses primarily on practical matters, and deals less with theory than does the Manual. It should be seen not as a replacement for the Manual but as a supplement.

In December 2003 the International Conference of Labour Statisticians, convened by the ILO, adopted a Resolution concerning consumer price indices. This Resolution replaced the previous Resolution on CPIs adopted in 1987. The ILO Resolution and the CPI Manual are compatible documents, and indeed the preparation of the draft Resolution was done in parallel with the preparation of the Manual. The text of the ILO Resolution is included as Appendix 3 to the CPI Manual itself.

In planning the present Handbook, it was decided that although designed for use by CPI practitioners in every country, special attention should be paid to the needs of developing and transition countries. The authors of each chapter were made aware of this policy from the start. The ILO, in collaboration with UNECE, carried out a user survey of the CPI Manual in order to elicit useful ideas for inclusion in the Handbook, and to discover more about the perceived limitations of the Manual. The survey was addressed to all national statistical institutes and also to other users such as ministries of labour and workers' and employers' organisations. Over 100 responses from a similar number of countries were received. More than half of respondents felt that more space should be devoted to practice related issues and the most useful chapter in the Manual was thought to be Chapter 9 on the practical aspects of CPI calculation.

Given the special focus on developing countries, it was decided that a panel of reviewers from such countries should be involved in the preparation of the Handbook. More than ten CPI experts from a representative group of countries were accordingly asked to comment on specific chapters. Their views were regarded as extremely valuable and the content of the Handbook has benefited as a result. For example, there are frequent references to the problems met in collecting prices in markets, which to the reader in a developed country may seem disproportionate, but to CPI practitioners in developing countries are crucial.

To assist readers of the Handbook, the chapter headings have been made as compatible as possible with that of the Manual. In terms of general ordering this has been achieved, though exact numerical compatibility is limited to just a few of the 18 chapters.

With its emphasis on practical matters, the Handbook has been written with a view to use by CPI statisticians working in national statistical offices. The various topic-specific chapters should be useful for practitioners faced with specific problems in certain areas of CPI compilation (e.g. how to deal with seasonal products or how to aggregate prices at the lowest level where there are no weights available). It is also hoped that the Handbook can be used for training purposes. The language used, as well as the style, has been deliberately aimed at a level which should be easily understood not only by CPI experts but also by new professional staff joining a CPI department in a national statistical institute. As with the Manual itself, an electronic version of the Handbook is available on the internet at http://www.ilo.org/cpi-manuals and is regarded as a "living document" that will be amended and updated as necessary over the coming years. As mentioned in the Introduction, there is an accompanying CD-ROM which includes not only worked examples which can be adapted using national datasets, but also the text of the CPI Manual, and some other useful background papers.

A guide to readers

The Handbook broadly follows the same sequence of chapters as in the Manual so that it covers in logical sequence the successive steps in index compilation. But it is not designed necessarily to be read from cover to cover. It is expected that compilers will be able to dip into it as required. Each chapter is self-contained, giving a brief summary of the corresponding chapter in the main ILO Manual before providing practical guidance. Illustrative examples of calculations and model documents are also presented to assist the user. The Handbook uses the same terminology as the Manual. Further details on the contents of the Handbook are given in Chapter 1.

The Handbook is not prescriptive where it cannot or does not need to be, and in these cases makes recommendations or gives examples of what might be considered best practice. The reader should bear two things in mind. Firstly, it is not always possible to give definitive practical guidance as this would wrongly assume that the solutions to conceptual problems are, themselves, always clear-cut and that there are no choices to be made about precisely how a practical solution is implemented. Secondly, what is applicable locally and what can be achieved on the ground will depend on the resources available to the individual National Statistical Institute.

Acknowledgements

The production of this Handbook was a collaborative effort involving many people. Authors of the individual chapters and their co-authors were drawn from CPI experts around the world and contributions were sought from experts with extensive experience in working on CPI issues in developing countries. The Handbook also drew on documentation from the UK Office for National Statistics and from work undertaken by the Statistical Office of the European Communities (Eurostat) in connection with the development of the European Union's Harmonised Index of Consumer Prices. The latter acted as a focal point for improving the compilation of CPIs in the European Union and significantly increased levels of understanding and expertise in CPI methodology.

David Fenwick was the Editor in Chief of the handbook and accompanying CD-ROM. John Astin the co-editor of the Handbook and Terry Offner the co-editor of the CD-ROM. The authors and, in brackets, co-authors of the individual chapters are as follows:

1. *Introduction* David Fenwick and John Astin
2. *The Scope of the CPI* John Astin (Paul Armknecht)
3. *Product Classification* Marc Prud'Homme (John Astin)
4. *Expenditure Weights in the CPI* Marc Prud'Homme (Paul Armknecht)
5. *Sampling Procedures* David Fenwick and Matthew Powell (Terry Offner)
6. *Price Collection* Terry Offner (John Astin)
7. *Substitution and Quality Change* Paul Armknecht (Walter Lane)
8. *New Products* Paul Armknecht (Matthew Powell)
9.1. *Special Cases - Housing* David Fenwick (Yoel Finkel, John Astin)
9.2. *Special Cases - Own Account Production* Keith Blackburn (John Astin)
9.3. *Special Cases - Services* Walter Lane (Marc Prud'Homme)
9.4. *Special Cases - Tariffs* Marc Prud'Homme and David Fenwick (Walter Lane)
9.5. *Special Cases - Seasonal Products* Yoel Finkel and David Fenwick (Marc Prud'Homme)
9.6. *Special Cases - Second-Hand Goods* David Fenwick (Paul Armknecht)
10. *Index Calculation* John Astin and Marc Prud'Homme (David Fenwick)
11. *Special Indices* John Astin (Marc Prud'Homme)
12. *Data Validation* Terry Offner (Matthew Powell)
13. *Sources of Errors and Bias in a CPI* Yoel Finkel (Paul Armknecht)
14. *Publication, Presentation, Analysis and Interpretation* David Fenwick (John Astin)
15. *Organisation and Management* David Fenwick and Yoel Finkel
16. *User Consultation* David Fenwick (Yoel Finkel)
17. *CPI/ICP Integration and Harmonisation* John Astin (Keith Blackburn)
18. *Quality Reporting and improving the CPI: Frameworks, checklists and work programmes.* David Fenwick (George Beelen)
19. *Glossary* John Astin

The quality of the Handbook was also increased by the valuable contributions of colleagues, including user input from CPI compilers in a number of national statistical institutes particularly in developing countries. Special thanks are due to staff at the African Development Bank and the Asian Development Bank, who provided useful comments, to the UNECE, ILO, the IMF, COMESA, and CEPAL who facilitated consultation with CPI compilers on earlier drafts, and to the following individuals who provided some helpful comments which were incorporated in the final text: Nelson Taruvinga; Vincent Musoke Nsubuga; Patrick Kelly; Saad Bashir; Phillip Miti; Sanjev Bhonoo; Nicholas Nsowah-Nsowah; Borbala Minary; Marietta Morada and Zakayo Msokwa.

I would like to thank my co-editor of the handbook, John Astin, who also drafted or co-authored a number of chapters. I am also grateful to Erwin Diewert, who took on the task of reviewing the more technical aspects of the handbook, including the scrupulous checking of formulae for errors and inconsistency in annotation.

The idea of a CD-ROM evolved during the early stages of drafting of the handbook and became a project in its own right. I am indebted to Terry Offner for applying his technical skills in undertaking much of the detailed work and for acting as my co-editor on the CD-ROM, and to Marc Prud'Homme for drafting the PowerPoint presentations, which are an integral and important part of the materials included in the CD-ROM.

The production of an international handbook, which relies on contributions from around the world, requires a great deal of co-ordination. Ben Whitestone (UK Office for National Statistics) took on the role of project manager and his efforts were a significant factor in the success of this project.

Finally, thanks go to the UK Department for International Development who funded the drafting of this Handbook, the UK Office for National Statistics who provided a great deal of day to day support and the United Nations Economic Commission for Europe (UNECE) for undertaking the printing and distribution.

David Fenwick
Editor in Chief

Contents

CHAPTER 1

Introduction

1.1 Consumer price indices measure changes over time in the general level of prices of goods and services that households acquire, (use or pay for) for the purpose of consumption. In many countries they were originally introduced to provide a measure of the changes in the living costs faced by workers, so that wage increases could be related to the changing levels of prices. However, over the years, CPIs have widened their scope, and nowadays are widely used as a macroeconomic indicator of inflation, as a tool by governments and central banks for inflation targeting and for monitoring price stability, and as deflators in the national accounts. With the globalisation of trade and production and the liberalisation of the markets, national governments, central banks and international organisations place great importance on the quality and accuracy of national CPIs, and in their international comparability.

1.2 Different conceptual frameworks can be used to address fundamental issues relating to nature of the index. For example, whether the CPI should measure the change in cost of a fixed-weight basket of goods and services or whether it should measure the change in the cost of living, i.e. the cost of maintaining a given standard of living, taking into account the fact that when prices change consumers change their expenditure patterns. The use and conceptual basis of the index will determine the method of construction, including the formulae used for the aggregation of prices.

1.3 The method of construction also allows (or should allow) CPIs to be adapted for a wide range of specific uses. For example, they can be adapted to calculate specific inflation rates for social groups such as pensioner or low-income households. Their product coverage can be adapted so as to show what the rate of inflation is in particular sectors such as energy or food, or excluding particular sectors such as alcohol and tobacco. They can shed light on the effect of tax changes or government-regulated price changes on the rate of inflation. They can be compiled on a regional basis, showing different inflation rates within different parts of a country or between urban and rural areas.

1.4 In short, consumer price indices are now considered as one of the most important economic and social indicators produced by National Statistical Institutes (NSIs) throughout the world. Against this background, the challenge of national statistics institutes 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; to construct the indices so defined and evaluate them against purpose.

Systems of Price Indices and supporting frameworks

Higher-level frameworks

1.5 The System of National Accounts 2008 provides the basic guidelines for building appropriate frameworks for CPIs and other price indices in the "family" of price indices, covering all major economic activity including, most particularly, production and consumption and intermediate outputs. In theory the System of National Accounts also provides a methodology for developing and extending the core system of price indices to meet specialised needs whilst maintaining consistency of approach, both in concepts and practical measurement, and coherence in terms of the definition, classification and measurement of flows and stocks of goods and services. The use of such frameworks also facilitates the examination of the relationships between different price inflation measures and can help analysts in their understanding and interpretation of inflationary signals. With their ability to identify statistical gaps, these frameworks can also facilitate future developments in the field of price statistics. One such framework is the Stage of Processing Framework (see Appendix 1.1).

Stage of Processing Framework

1.6 A "Stage of Processing" framework has a useful role to play in informing policy formation. It can also provide the basis for systematically analysing the build-up of inflationary pressures in

the economy and for tracking relationships between price developments in particular sectors. From a compiler's point of view it also provides a useful tool for identifying gaps in available price index series and a focal point for investigating coherence in index construction.

1.7 The first step in constructing such a framework is to divide the entire economic process into distinct stages:

- *Rest of the world*
- *Production*: split into broad categories such as agriculture and manufacturing (and further sub-divided into primary, intermediate and final production).
- *Final demand*: separated into private final consumption, government consumption, capital purchases and exports.

1.8 The main series of price indices are then grouped according to coverage. For instance, this might be as follows:

- *Consumers' expenditure* (Consumer Prices Index).
- *Other elements of Final Demand* (an Index of Government Prices [IGP] and an Index of Investment Prices [IIP].
- *Inputs into and outputs from the manufacturing sector* (the Producer Prices Index [PPI]).
- *Trade price indices*

1.9 In principle, for all significant transfers of goods and services from one part of the economy to another, there should be a representative price index (based on directly-measured prices) that reflects the changing level of prices for all such goods (or services).

1.10 The Stage of Processing Framework is shown in Appendix 1.1. The source of the goods/services is shown down the left side of the table; the destination is shown along the top of the table. For instance, the prices charged by the manufacturing sector for consumer goods sold to the retail/wholesale sector are reflected in the PPIs (Producer Price Indices). The prices charged by the retail sector for consumer goods sold to private consumers are reflected in the CPI. Across the top of the table are the buyers, classified into two broad groups: intermediate demand and final demand. Most sectors of production are involved in both buying inputs and selling output - so they appear in the table both as buyers and as sellers. In practice, in some cells transactions from seller to buyer will be insignificant and these are denoted by a dash. For instance, there are unlikely to be any imported goods feeding into the construction sector as intermediate demand. In the example in Appendix 1.1, which for illustrative purposes has been populated on the basis of a typical situation, the shaded cells represent significant transactions in the economy for which there are no relevant price indices. Where published indices do exist, the name (or acronym) of the index is given. For instance, the sale of finished goods by retailers to private final consumption is measured by the CPI.

1.11 The practical advantages of using a Stage of Processing Framework can clearly be illustrated:

- The associated table of inflation rates can be used for analytical purposes and help inform economic policy.
- Aggregate price indices (and inflation rates) for each row and for each column may be computed to produce inflation rates for different sectors.
- Possible enhancements to currently published indices can be identified.
- Major gaps can be identified.
- Issues relating to statistical integration and coherence and can be also identified. For example, issues relating to coherence in concepts and practical measurement arise when combining rows and columns.

Lower-level Frameworks

1.12 Higher-level frameworks can be supplemented by lower-level frameworks such as the Stage of Production Framework. The latter, which can be used for in-depth investigation of the Producer Price Index, is not expanded upon here.

1.13 The lower-level theoretical framework for CPIs is essentially based on economic theory relating to consumer behaviour. In this context the Schultze Panel on Conceptual, Measurement, and Other Statistical Issues in Developing Cost-of-Living Indexes makes a distinction between the traditional CPI based on a fixed-weight basket, as being a cost-of-goods index (COGI), and a cost-of-living index, which measures the change in expenditures a household would have to make in order to maintain a given standard of living or utility. 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 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.

1.14 The different uses of a CPI set within these frameworks determine a number of measurement issues including the choice of index number formula.

Choice of index number formula

1.15 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).

1.16 Experts generally agree that the ideal type of index for a CPI would be a "superlative" index such as the Fisher index. Superlative indices make equal use of the prices and quantities in both of the periods being compared (such as the base period and the latest month). In reality, quantities for recent periods are almost never known, so that in practice nearly all NSIs produce CPIs which rely on quantities relating to a base period some time earlier.

1.17 Some countries aim to produce a "cost of living" index (COLI). But such an index is in fact a type of superlative index and suffers from the same practical defect as mentioned above.

1.18 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 will span, say, a year rather than a point in time. This is because the main source of weights data is a Household Budget Survey (HBS) 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 HBS period weights are used without adjustment, or they are price-updated to the price reference period. Either of these methods results in a Lowe index, but is often referred to as a "Laspeyres-type" index. The CPI Manual (Chapter 1) goes into considerable detail on these and other index number types.

1.19 The Handbook in general is based on the assumption that the index being compiled is a Lowe (or Laspeyres-type) index.

Index Formula at Lower (Elementary Aggregate) Level

1.20 The first stage in the calculation of CPIs is the calculation of elementary price indices, which are then aggregated to obtain higher-level price indices. Expenditure weights are not usually available below the elementary aggregate level. The three most widely known elementary index formulae are the Carli, the Dutot and the Jevons and each is associated with a number of assumptions which will impact on measured inflation. The Carli (a simple arithmetic average of price relatives) and Dutot (the ratio of simple arithmetic averages of prices) formulae have a number of problems associated with their use – particularly the Carli, which is positively discouraged as it is particularly associated with some bad characteristics. Because of this the Jevons formula (the ratio of simple geometric averages) is increasingly used. It should be noted that an arithmetic average is always greater than or equal to a geometric average and that the difference will be greater the greater the variance in the price relatives. The choice of formula becomes more important the greater the diversity of price movements which is one argument for ensuring that elementary aggregates are as homogeneous as possible.

Acquisition, use, or payment approach

1.21 A CPI is based on the measurement of the change in prices of the goods and services included in the basket. The vast majority of goods (but not necessarily of total values) are priced in the retail outlets selling them. It should be noted that in normal circumstances the prices recorded are the labelled prices, which are assumed to be the prices

actually paid by consumers. It is also generally assumed that payment for the goods is made at the time of purchase – indeed the consumer would regard the two events as identical. However, payment can be in cash or on credit, including credit cards for which the due date of payment may be several weeks after the actual purchase.

1.22 The time factor is important in other ways too. A shopper may decide to buy a larger than normal quantity of a particular good if there is a special price reduction. The product may then be stored at home and "consumed" (i.e. used) over a relatively long period. Cans of food, for example, offered cheaply for a limited period, may be stored at home without deterioration for months and consumed at the usual frequency.

1.23 Another issue concerns the definition of "usage". A bottle of milk will typically be consumed within a few days of purchase. Consumption is likely to take place in the month for which the CPI is calculated. But a semi-durable such as a shirt will be worn many times over a period of probably several years. A durable such as a television set may be used for a decade or more and a house over an even longer period of time. The question arises as to which CPI month (or months) should the purchase be allocated.

1.24 With services these questions can be even more complex. Take, for example, the purchase of a season ticket for a bus service. This may be a single payment for a pass which gives "free" bus transport for a year. It can be seen that although this example is clearly a service (the use of bus transport over a period of time) it has much in common with the purchase of a durable such as a television or shirt which provides a type of service over a long period. A service such as a medical operation can also be regarded as durable, since it is likely to give long-term health benefits to the patient.

1.25 CPI theory devotes much thought to these issues, which can have important implications not only for how a CPI is compiled but for the results themselves. Three different approaches can be identified:

- The *acquisitions approach* relates to when the good or service is acquired, irrespective of when it is actually used or consumed. The time of acquisition of a good is the moment at which the legal ownership of the good passes to the consumer. This is usually the point at which the purchaser incurs a liability to pay. On the other hand, with a service there is no change in ownership; it is "acquired" at the time the producer provides it (e.g. the bus journey). A CPI based on this approach measures the change in the cost of acquiring a product. The timing of the recorded prices should be consistent with the way in which the value would be recorded in the expenditure data used for the CPI weights.
- The *use approach* relates to the period over which the product is consumed or used; a CPI based on this approach measures the change in the cost of using the product over time; in other words the cost of the good is distributed over its useful life. Expenditures on durable goods and services are liable to fluctuate.
- The *payments approach* relates to the period of time when the actual period-to-period payments for the product are made. This can differ from the period when it is acquired and when it is used. When payments are not made in cash, there may be a long period before the purchase is paid for, whether by cheque, credit card or other method. The time at which these debits are made is irrelevant for the recording of the price. The price to be recorded is the price payable at the time of acquisition (though sometimes the method of payment may itself affect the price).

1.26 Statistical offices need to have a clear policy on which of these approaches is used in its CPI. In practice, the choice between the three approaches is an issue relating to durable goods and its impact is likely to be limited to the weight given to owner-occupier housing costs. The latter is discussed in Section 9.1 of the Handbook. In countries where food expenditures and other expenditures on non-durables, semi-durables and even services account for a significant share of the CPI basket and where credit financing is rarely used, the acquisition, use and payment approaches will give very similar results and hence the CPI can satisfy many uses equally well. This is the principal reason why most countries use, either implicitly or explicitly, the acquisitions approach to define what constitutes consumption expenditure.

Contents of the Handbook

1.27 The compilation of CPIs is highly complex. Readers will note that it occupies eighteen chapters of the Handbook. Although each chapter deals with a particular topic, it is inevitable in such a complex process that there are many inter-dependencies between the topics. It is not possible to make decisions on sources of weights data without first deciding on such factors as geographical and population coverage, for example. So there are many cross-references within each chapter.

1.28 The following summary of the contents of each chapter draws attention to some of the more crucial links between chapters.

- **Chapter 2** on the scope of the CPI, covers such issues as: the different uses of CPIs; geographical coverage (including regional coverage); the reference population; the choice between democratic and plutocratic weights; the exclusions of certain products such as narcotics; and the treatment of imputed transactions and imputed prices.
- **Chapter 3** deals with the subject of product classification, and focuses almost entirely on the standard international classification COICOP.
- **Chapter 4** is devoted to the important issue of expenditure weights. There are links to issues dealt with in other chapters, including: plutocratic and democratic weights; the acquisition, use or payments approach to the recording of prices; the treatment of taxes and subsidies; the population and geographic coverage; the treatment of own-account production; the treatment of in-kind remuneration; and the coverage of second-hand goods. All of these topics are dealt with in greater detail in other chapters. Chapter 4 covers in depth the sources of weights data, including Household Budget Surveys and adjustments which may be needed; the weights reference period and price-updating; and the use of weights in calculating the overall index.
- **Chapter 5** deals with the complex issue of sampling. CPIs necessarily rely on the use of samples covering time, location, outlet-type, product type, and detailed product specifications. All of these aspects of sampling are dealt with in Chapter 5.
- **Chapter 6** on price collection, follows logically from Chapter 5. It deals with most of the practical aspects of price collection, including: frequency and timing of collection; period or point-in-time pricing; outlet types; seasonal availability (also dealt with in Chapter 9); price volatility; the management of price collection including quality control and documentation; staff management and training; methods of recording prices; treatment of special offers and discounts; bargained prices; central collection.
- **Chapter 7** deals with the problems which occur when products or outlets become unavailable, either temporarily or permanently. The chapter covers the important questions of substitution (replacement) and quality adjustment.
- **Chapter 8** covers the treatment of newly available products. It deals with planning for the introduction of new products; the timing of their introduction in the CPI; sample rotation; how to add a new elementary aggregate; and the consequential effects on the calculation of the overall index.
- **Chapter 9** deals with a variety of specific goods and services which need special treatment. They are:
  - *Owner-occupied housing* – the various methods of attributing values to the shelter costs of owner-occupiers.
  - *Own-account production*, with particular emphasis on home-produced food.
  - *Certain services*, in particular health and educational services, where there are usually issues concerned with "free" or highly-subsidised provision.
  - *Tariffs* – such as those used in utilities like public transport, gas, electricity and water supply, etc.
  - *Seasonal products* – methods of dealing with products (especially fresh food products) which are available in certain months but not in others.
  - *Second-hand goods*, such as clothing and motor cars. The chapter covers situations where second-hand items are traded via dealers or directly between households, and distinguishes between imported and domestic products.
- **Chapter 10** is devoted to the detailed methods of calculation of CPIs, focussing in turn on the compilation of elementary aggregate indices and then the staged aggregation to the overall CPI. It covers such issues as the stratification of elementary aggregates; the use of implicit weights within elementary aggregates; the pros and cons of various elementary aggregate formulae; the choice of formula for calculating the aggregate indices; and the chain-linking and splicing of indices.
- **Chapter 11** deals with the calculation of variants of the standard CPI, including: indices relating to particular socio-economic groups; regional CPIs; indices excluding certain product groups such as alcohol and tobacco; constant-tax indices; and seasonal adjustment of the overall CPI.
- **Chapter 12** deals with data validation at all stages of compilation of a CPI. This includes checking at the initial input stage; credibility

checking; the auditing of compilation processes; output-editing of results; the treatment of outliers; data editing, including the use of algorithms such as the Tukey algorithm.

- **Chapter 13** deals with the sources of errors and bias, including advice on how to minimise them. It deals specifically with questions of bias in elementary aggregates and upper level substitution bias; quality change and new products bias; new outlet bias; and different sources of sampling and non-sampling error.
- **Chapter 14** deals with issues concerning the publication of CPIs, including analysis and presentation. Specific points covered are: timing of publication; pre-release announcements and access; associated political statements; examples of detailed procedural arrangements; press releases; revisions; special presentations and analyses.
- **Chapter 15** addresses a wide range of issues to do with the organisation and management of the whole CPI production process. It describes typical quality management processes; internal auditing; review systems; and risk assessment and disaster planning.
- **Chapter 16** is concerned with CPI user consultation, focussing in particular on the use of CPI advisory committees.
- **Chapter 17** addresses the subject of integration of the CPI production process with the ICP (International Comparison Program for Purchasing Power Parities). It examines the differences and similarities between the two programs – one spatial, the other temporal, and suggests ways of achieving maximum overlap and hence efficiency benefits. It also discusses ways in which both processes can achieve mutual statistical improvements in their results.
- **Chapter 18** provides guidance on reporting mechanisms for providing users with the meta-data that they are entitled to on the characteristics, quality, access and integrity of the CPI and, correspondingly, the information that a national statistical institute needs to monitor in order to know whether it is meeting user needs and to put in place a programme of improvements. In particular, the chapter looks at the use of quality frameworks and checklists.

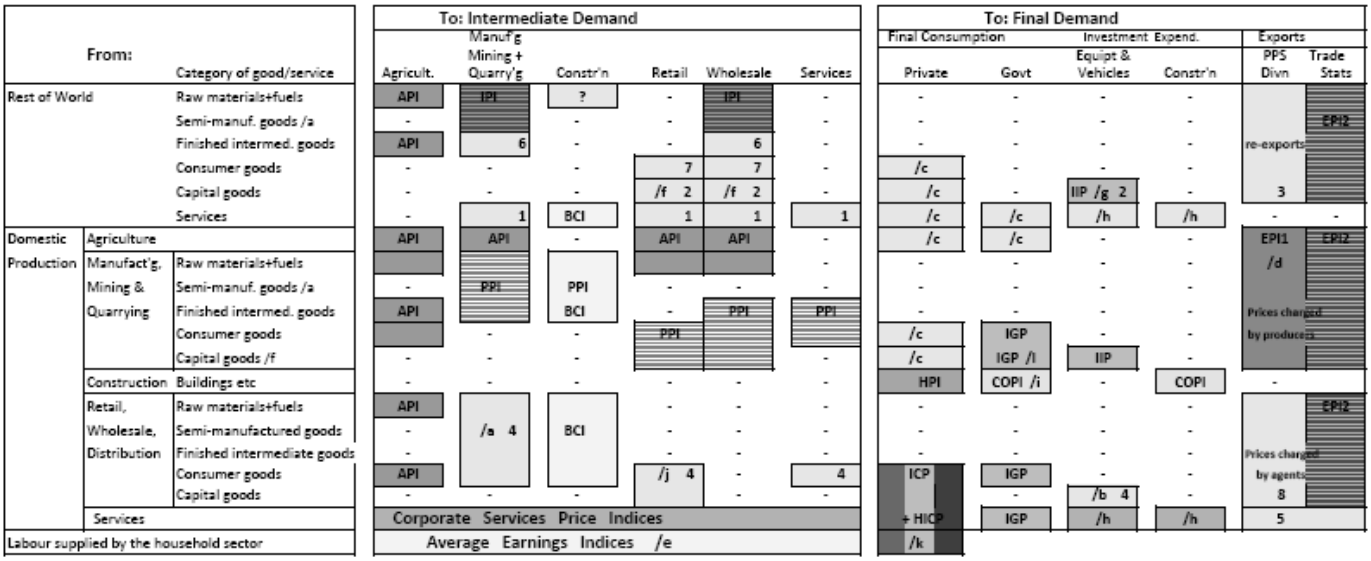
Terminology in the Handbook

1.29 The field of consumer price indices uses very little terminology specific to the subject. It uses many terms in general use in statistics and economics, such as “sample”, “index” and “weight”. It also uses many words and expressions which are used in common language: examples include “product”, “item” and “basket”. These words can have very specific meanings in a CPI context. In recent years there has been a marked increase in the degree of international discussion and co-operation amongst CPI experts, and this has had the fortunate result of bringing about greater harmonisation of terminology. It has also drawn attention to the problems of translation, especially amongst the second group of commonly used words mentioned above.

1.30 The CPI Manual includes a lengthy glossary which it is to be hoped will assist in the gradual harmonisation of terminology. This Handbook has wherever possible used the same terms as are found in the Manual’s glossary. There is, however, a separate glossary so that readers do not need to consult the glossary in the Manual. Most of the definitions are identical, but in some cases the wording has been changed to improve clarity. Some new words and phrases have been added, while some not referred to in the Handbook have been omitted.

1.31 Care has been taken to use throughout the Handbook the same words and phrases where these refer to the same object. This has been done for the sake of consistency, since it could be misleading to the reader to use different terms for the same object. An example is the use of “Household Budget Survey” for the type of household survey which requires households to state their expenditures on various products or groups of products. Countries often use a different name for their equivalent survey, but reference to the glossary will explain what is intended. Consistency has also called for a uniform title to be given to such bodies as National Statistical Institutes (NSIs), regardless of their actual names, which vary considerably.

Appendix 1.1 Stage of Processing Framework



/a from wholesalers/dealers/import agents

/b capital eqpt purchased through wholesalers/agents are not covered by the IIP - which reflects changing levels of output prices (ie manufacturers list or order prices)

/c there may be direct purchases, but such transactions are not reflected in any published indices

/d The only export prices collected by PPS are from the producers (EPI1s). The EPI2s published by Trade Stats cover all exported goods; but only the EPIs determined by PPS are based on direct price collection

/e this block is equivalent to the sale of labour by private households to the productive sectors of the economy

/f most capital goods will, by definition, feed into intermediate demand - but capital goods purchased for re-sale by dealers (eg cars) will be classified as intermediate demand

/g not yet based on directly-collected prices - but an estimate of imported capital goods prices is made for the FEPI (and for the PINCCA)

/h expenditure on services incurred as an integral part of the acquisition of capital goods is classified as part of investment expenditure

/i output from the construction sector feeds into Govt final consumption (why?)

/j from wholesale to retail

/k eg domestic help

/l capital goods that feed into Govt Final consumption (eg PCs costing < £1000)

Construction Output Price Indices	COPI
Building Costs Indices	BCI
House Price Index	HPI
Import Price Indices	IPI
Export Price Indices (PPS Div)	EPI1
Export Price Indices (Trade)	EPI2

Producer Prices Index	PPI
Components of the FEPI (ICP + IIP + IGP)	FEPI
Harmonised Index of Consumer Prices	HICP
Agricultural Purchaser and Producer Price Indices	API
No price indices published for these transactions	

CHAPTER 2

The Scope of the CPI

Introduction

2.1 Chapter 1 of the CPI Manual provides a summary of the background to CPI methodology. Paragraphs 1.8 to 1.12 provide some background on the origins and use of CPIs, including their evolution from compensation indices to macro-economic indices used by government to set inflation targets, and paragraphs 1.13 to 1.146 discuss the characteristics of the different index formulations available and their different properties, including the tests that can be applied in deciding which formulation to adopt in different circumstances. Much of the remaining parts of Chapter 1 cover issues relating to concepts, the scope and definition of a CPI and a wide range of other subjects confronting the index compiler including the acquisition, payments and user-cost approaches, cost-of-living indices, the construction of expenditure weights and the collection of prices data. Chapter 2 of the CPI Manual discusses in greater detail the different uses of a CPI and the practical consequences for the price statistician.

2.2 The ILO Resolution on CPIs specifically addresses the scope of the CPI in paragraphs 8 to 14 and makes the point that "the scope of the index depends on the main use for which it is intended" and "should be defined in terms of the types of households, geographical areas, and the types of consumer goods and services acquired, used or paid for by the reference population".

2.3 A CPI can be used for a variety of purposes, the more common ones being: the indexation of wages, rents, contracts and social security payments; the deflation of household consumption in the national accounts; as a general macroeconomic indicator, especially for inflation targeting and for setting interest rates. Elements of a CPI are also often used in the calculation of purchasing power parities (PPPs) required in the International Comparison Program (ICP)[1].

2.4 Given the many uses of CPIs, it is unlikely that one index can perform equally satisfactorily in all applications. Some countries therefore construct several CPI variants for specific purposes. Each index should be properly defined and named to avoid confusion and a "headline" CPI measure should be explicitly identified. Where only one CPI is published, it is the main use that should determine its type and scope. If there are several major uses, compromises may have to be made with regard to how it is constructed. The purpose of a CPI should influence all aspects of its construction. CPI producers need to know how their index is being used if they are to ensure that it is fit for purpose. In this connection user consultation is important. Chapter 16 provides detailed advice on consultation procedures.

2.5 This chapter reviews the issues confronted by the index compiler relating to the scope of the index and the practical measurement and compilation decisions which have to be made. But before doing so it reviews the various uses of a CPI to put the discussion in context.

The different uses of a CPI

2.6 CPIs have three main uses:

- *Indexation*
  A CPI used for wage or contract indexation of any specific group, whether of population or of products, should represent the coverage of the group concerned. For instance, it can be argued that the weights of a CPI used for indexation of pensions should cover only the expenditure of the pensioner population. The product and outlet list could also be more appropriately targeted, if the data exist. This means, for example, that a CPI used for indexing pensions may use weights relating to pensioner households and may exclude products which may be thought largely irrelevant to, say, poorer households, such as luxury items or brands. Similarly, for domestic indexation, the CPI should cover only the expenditure of the resident population (see section below on "Geographical coverage"). More generally, it has to be decided whether the CPI should be, in principle, a cost-of-living index or a pure price index – these two very different concepts are discussed in Chapter 1.

[1] See Chapter 17.

For certain very specific types of indexation, such as for rents, users may prefer to use just the sub-index for rents. In such cases, the sub-index should be of a statistical quality sufficient for that purpose.

- *National accounts deflation*

  This use requires consistency between the prices data used for the CPI and the expenditure data used in the national accounts. Both data sets should cover the same set of goods and services and use the same concepts and same classification, which for national accounts would be COICOP. For example, the national accounts require the valuation of own-account consumption, whereas this is often excluded from the CPI either as a matter of principle or for pragmatic reasons. This applies to the valuation of the services of owner-occupied housing as well as the consumption of own-produced food.

- *Inflation targeting*

  It can be argued that central banks ideally need a timely index relating to total inflation, not just consumer inflation. But NSIs generally are unable to construct such indices, in part because of the measurement issues relating to government consumption. In the absence of such an index most central banks rely on a CPI, using the domestic concept but measured on as wide a basis as possible, in terms of both products and geographical coverage. The same applies to the use of the CPI as a general macroeconomic indicator.

2.7 The remainder of this chapter considers in more detail the issues which arise and provides an introduction to topics which are dealt with in more detail in subsequent chapters. In particular, the reader is referred to Chapter 4 for more detailed advice on the issue of democratic versus plutocratic weights and on taking into account the national versus domestic concepts, institutional households and own-account consumption in the construction of weights. Chapter 9 addresses in more detail the issue of second-hand goods.

Geographical coverage

(References: CPI Manual 3.97-3.104; ILO Resolution 10-12)

2.8 There are two distinct aspects to the question of the geographical coverage of a CPI. The first relates to the country as a whole, the second to its regions.

The national versus domestic concept

2.9 A CPI can have "national" or "domestic" coverage.

- *National* coverage means that the CPI should cover the non-business expenditure (and prices) relating to the resident population of the country, regardless of where the expenditure takes place. The national concept is appropriate when the CPI is being used for indexation of incomes. The weights for expenditure abroad can be included in the Household Budget Survey, but measuring prices paid abroad poses serious problems. The national concept thus poses some major measurement problems.

- *Domestic* coverage means that the CPI should cover all the expenditure made within the domestic territory of the country, including the non-business expenditure made by foreign visitors. It is appropriate where the CPI is used for national inflation analysis and inflation targeting. Many countries carry out surveys of the expenditures of foreign visitors, for example, via International Passenger Surveys conducted at major border crossings and airports. This is particularly important for those countries which have a large number of foreign tourists, or a high level of cross-border shoppers.

  Foreign visitors will generally have very different expenditure patterns from those of national residents (e.g. they will spend more on hotels and restaurants) and to omit them could introduce serious distortions into a CPI aiming to follow the domestic concept, especially if the main purpose of the index is to measure the inflationary trends in the economy.

2.10 Purchases made via the internet from foreign websites or websites of retailers based abroad should be included if a CPI is based on the *national* concept. So also should purchases made abroad more generally, including such items as fees for foreign boarding schools, even if the item, in this case education, is consumed outside the country. Where such purchases are made in the foreign currency, they should be converted to the domestic currency at the relevant exchange rate. Clearly it would be impracticable to collect prices directly in foreign countries on a continuous basis although surveys of prices done in order to compute purchasing power parities may provide an occasional benchmark. Where the regular collection of the relevant prices is not practical, it may be possible to obtain a reasonable proxy for price movements

using published sub-indices of the other countries' CPIs.

2.11 Although no firm rules exist about the treatment of internet shopping in respect to the domestic concept, most countries which have examined the issue have concluded that internet shopping from domestic websites, and paid in the national currency, should be included.

Regional coverage

2.12 As far as regional coverage of the CPI is concerned, the general rule is that a national CPI should cover expenditures and prices throughout the country. However, comprehensive coverage is not always necessary, especially if regional CPIs are not published and the sampling scheme ensures that the index is representative of the whole country. In such situations, CPI compilers should collect evidence from time to time on the trends in prices in different regions over periods of time which cover differences in seasonal variations etc, to ensure that the sample remains representative. Any region which shows price trends significantly different from the others should be covered by the CPI if its inclusion is likely to have a significant effect on the national CPI and will improve representiveness. But there is little point in spending scarce resources collecting prices in sparsely populated regions if to do so would have little or no impact on the national CPI. When carrying out such sensitivity tests regional weights can often be an issue. In this case population may sometimes be used as a proxy for regional consumer expenditure. However, where regional CPIs are aggregated to compute the national CPI, weights should be based on regional expenditure rather than population data.

2.13 Clearly, if a country produces regional CPIs, each region would normally be covered, even those with sparse populations. But the cost of mounting such surveys is often felt to be a barrier to producing such indices.

2.14 Another difficulty regarding regional CPIs is related to the "national" versus "domestic" concept. It can sometimes be the case that a household lives in one region but does most of its shopping in an adjacent region, particularly when a household lives close to a regional "border". The question of whether the expenditure weights and the prices should be allocated to the region of expenditure or the region of residence is usually dictated by practical issues. As with the national concept discussed above, if the region of expenditure is used (equivalent to expenditure abroad by a domestic resident) some means has to be found of estimating the proportions of expenditure made by "visiting" consumers in the various regions so that this can be reflected in the prices.

2.15 Finally, the question often arises as to whether a CPI can be limited to urban areas or if rural areas should also be covered. Again, in principle the whole territory should be covered, but clearly the impact on the national CPI of including rural areas where relatively few monetary transactions take place will often argue against their inclusion on grounds of cost. But the view taken will depend, at least in part, on the size and treatment of own-account production. If own-account consumption is included in the CPI, the weights should include a valuation of the physical quantities of such products, the latter often derived from the Household Budget Survey. The prices will normally be the same as those used for actual transactions for the same goods sold in the same locality.

2.16 Where the weights derived from a Household Budget Survey are available for rural as well as urban households it is generally better to use the weights for urban and rural households combined, even if price collection is limited to urban areas, as this will normally improve the representiveness of the index. But, where feasible, price statisticians should undertake pilot calculations to test whether this is the case.

Reference population for the CPI

(References: CPI Manual 3.90–3.96; ILO Resolution 10-12)

2.17 Households comprise one or more individuals living together and sharing resources. The official UN definition also includes people living in military accommodation, convalescent homes and boarding schools. Such people are treated as belonging to private households. But for the purposes of CPI construction consideration must also be given to the inclusion of other institutional households, such as those living in religious institutes, hospitals, prisons, retirement homes etc. Temporary foreign workers may live together in special housing blocks, which may also be treated as institutional households in the population census. Expenditure on accommodation and living costs, such as lodging fees and charges for meals, imposed by the institution, as well as personal expenditure by the individual on, for example, clothes and toiletries, should be included in the CPI. However, care should be taken to ensure there is no double counting where, for instance, a family rather than an individual pays the accommodation costs charged to a patient in a hospital. The Household Budget Survey should be designed to pick up the amount spent on such

charges just once and the standard convention is to record it against the household which incurs the costs. In the above example, the accommodation costs should be included under the expenditure of the family, and not the individual. If individuals spend their own money on clothes and other incidental expenditure then the Household Budget Survey should record this expenditure as being incurred by the individuals. In reality, many Household Budget Surveys do not cover institutional households and, where this expenditure is considered to be significant, estimates will need to be made from, for example, special surveys of people living in institutions or by reference to the expenditure patterns of similar people, say, the same sex, age and socio-economic group, living in non-institutional households.

2.18 In reality, in considering the practical issues relating to the inclusion of institutional households in a CPI, two questions need to be asked. First, is the expenditure pattern of institutional residents likely to be significantly different from household residents? Secondly, even if the answer is yes, would their exclusion from the CPI be likely to significantly affect the national (or regional) CPI? To answer these questions, some research should be carried out on a sample basis.

2.19 Some countries exclude certain household types from the CPI, such as the very wealthy or the very poor. Such exclusions may be on theoretical grounds (for example, using the argument that the expenditure of the wealthy, who are relatively few in number, should not be allowed to affect a CPI which may be used for indexation of wages of ordinary workers) or on practical grounds (for example, using the argument that wealthy households tend to have low response rates to Household Budget Surveys, and their inclusion can lower the quality of expenditure weights). For a CPI which is used for indexation of wages, the exclusion of pensioner and wealthy households may be justified on conceptual grounds. For example, it may be considered that such households are likely to spend their money on atypical things and including them would distort the relevant overall average. It is also argued by some that the inclusion of pensioner households should be excluded in principle from an index used for the up-rating of state pensions because of the circularity involved (the level of state pension influences expenditure patterns which are then used in the up-rating calculation) whilst others would argue that it is logical that indexation should be based on an index reflecting the expenditure of pensioner households and their specific inflationary experience. Note that if wealthy households are excluded, the CPI basket should not include products likely to be bought only by the excluded group, nor should outlets specialising in such products be included in the sample. Conversely, if the wealthy are included, some "luxury" products and outlets should also be included in the sample. For the analysis of national inflation, it is considered that the more comprehensive the CPI the better.

Democratic versus plutocratic weights

2.20 A "democratic" CPI uses weights which average unweighted expenditure proportions over the whole population, rather than dividing total aggregated expenditure by the population. The latter method gives more weight to the high-spending households, and is referred to as a "plutocratic" index. It is argued that a democratic index is more suitable for showing the impact of inflation on the average household but in reality is very rarely computed by NSIs. There is a general consensus that a plutocratic index is the appropriate index to use for national accounts deflation or for a general measure of inflation.

2.21 Many countries publish a range of CPIs relating to sub-sectors of the population such as: all households, low-income households, pensioner households etc but a CPI based on "democratic" weights is very rare.

Product exclusions

(Refs: CPI Manual 3.39-3.73; 3.121-3.127; ILO Resolution 13-14)

2.22 In its role as an indicator of total consumer inflation, the CPI should in principle cover all types of goods and services which are consumed in the national retailing market. In practice, some types of product may be excluded for policy reasons while other exclusions are unavoidable in practice. These may include: *goods sold illegally, such as narcotics; black market sales; gambling; and prostitution*. In most of these cases, there will be no expenditure data from the Household Budget Survey or national accounts and prices are difficult if not impossible to collect. Whilst many would consider it inappropriate to have wages indexed to a CPI which includes, say, illegal narcotics, it should be noted that the valuation of the totality of the narcotics market, and indeed, the non-observed economy in general, is now a requirement for the SNA as far as GDP estimates are concerned. Thus, in principle, estimates of weights and prices will need to be made for the purpose of producing deflators, even if the expenditure is not covered in the CPI. Solutions will

need to be found to the practical measurement issues. For instance, if a CPI covers gambling, it is not the gross stakes which should be included in the weight, but the net stakes, which is broadly equivalent to the margin taken by the gambling operator. As this is not likely to be measurable, one solution may be to distribute the weight for gambling across other classes in COICOP group 09.4 (Recreational and sporting services).

2.23 The treatment of *second-hand goods* is often found to be problematic. As far as transactions within the household sector are concerned, sales will balance purchases (apart from any dealer charges), so the effect on the CPI is close to zero, and they may be excluded. But in many developing countries there are significant sales of imported second-hand goods, such as cars and clothing. Where sales of imported second hand goods are significant relative to sales of new goods of the same product, such sales should be included, both in weights and prices.

2.24 CPI compilers sometimes face proposals from governments or pressure groups to exclude certain categories of product for non-statistical reasons. A common example is alcohol where in some countries its consumption is associated with social stigma or it can only be purchased illegally. While it is acceptable to produce a variant of the general CPI excluding such products, the main CPI should include them, where practical, to ensure that the index presents a true and accurate picture of national inflation.

2.25 The CPI Manual and the appropriate sections of this Handbook cover in some depth the treatment of other excluded or partly-excluded products, including: taxes and licenses, subscriptions, insurance, gambling, financial transactions, hire purchase and interest payments.

Imputed transactions and imputed prices

(Refs: CPI Manual 3.74-3.89; 3.130-3.132; ILO Resolution 17-18)

2.26 A distinction can usefully be made between imputed transactions and actual transactions where a price is imputed. In the second category would be a prescribed medicine provided free as part of a national health service. There is a "transaction" in the sense that a product changes hands but at "zero" price so that it doesn't constitute a monetary transaction. The conventions for a CPI constructed for the purposes of indexation or the measurement of inflation as a macro-economic indicator exclude from coverage this category of non-monetary transaction, so no price should be imputed.

2.27 A CPI should measure the prices of final consumption by a household. In principle, the first category, imputed transactions where households do not incur a financial liability but bear the costs of acquiring the good or service in another way, should be included in a CPI where used for GDP deflation and, in principle, can be included in a CPI compiled for other purposes. Perhaps the most important example is the consumption of own-produced products such as food. Here, there is no actual transaction at all, and thus no price. If the "transaction" is to be valued a price has to be imputed. This would usually be done by reference to actual purchases of the same product in, say, nearby markets. But even when this is done for the purpose of estimating GDP (which values consumption regardless of its market mechanism) it is not necessarily appropriate to include it in the general CPI or in a CPI used for indexation where the narrowest concept of consumption that can be used is one based on monetary expenditures only. Both the CPI Manual and the ILO Resolution leave this latter question open, but, from the point of view of measuring inflation and also for the purposes of income indexation, the most common view is that it is best to omit it on pragmatic grounds although goods and services purchased by households which are then used as inputs into own account production are normally treated as if they themselves were consumption goods and services, and should therefore be included in the CPI. Some countries may find it useful to produce two versions of the CPI: one including and the other excluding own-account consumption.

2.28 The treatment of owner-occupied housing, which involves the own consumption of housing services, is dealt with separately in Chapter 9.

CHAPTER 3

Product Classification

3.1 Paragraphs 3.144 to 3.168 of the CPI Manual, deal with the subject of classification systems. The paragraphs list the criteria for establishing a relevant classification system for a CPI. These are that: the classification must reflect economic reality: meet the needs of users of CPI sub-indices; be unambiguously mutually exclusive and exhaustive (that is, providing full coverage). The paragraphs then go on to review the different classification schemes available to the CPI compiler and describe in some detail the international standard classification of individual consumption expenditures – COICOP (Classification of Individual Consumption according to Purpose). Paragraphs 20 to 22 of the ILO Resolution reiterate the point about addressing the needs of users of sub-indices and go on to state that for international comparisons the classification used for a CPI should be compatible with COICOP at least at its division level.

Introduction

3.2 The importance of the product classification system cannot be overstated. Choosing a classification system is the first step in compiling the CPI because its sub-aggregates must be defined in such a way that the expenditure weights and prices will relate precisely to the coverage of the sub-aggregates.

3.3 The classification is important also because it establishes a framework from whose boundaries the representative items for inclusion in the index (and sometimes the outlets) will be defined and drawn.

3.4 Finally, the classification system helps in defining which level of the hierarchy will be suitable for publication.

3.5 Classification is a central theme in the compilation of the CPI. In years past, countries used their own distinct systems for classifying the range of products covered by their CPI. Most countries have now, however, moved to the international standard classification COICOP – see above. This chapter will therefore draw upon COICOP unless otherwise noted.

3.6 It should be emphasised that the chapter should benefit CPI compilers in two ways - even for those that have not adopted COICOP. First, the chapter may help in understanding more fully the advantages of COICOP and provide some guidance for moving to a COICOP structure if this is a future objective. Second, some of the issues that are raised in this chapter will be relevant for many aspects of CPI classification regardless of the one actually used.

3.7 COICOP was first developed for the System of National Accounts (SNA 1993) to provide the structure for classifying household consumption expenditure. Expenditures on the various components of household consumption are often used as the basis for the weights in the CPI (see Chapter 10). The 2003 ILO Resolution on CPIs requires that national CPI classifications should be reconcilable with COICOP at least at its higher aggregation levels. Many countries have adopted COICOP in their economic statistics (for example, in the CPI, national accounts, International Comparison Programme (ICP), and household budget surveys), with a clear advantage for integration of data-sets and enhanced analytical capabilities.

Classification systems: the general case

3.8 In its broadest sense a classification is a procedure in which individual items are organised into categories based on information on one or more characteristics inherent to the items. A classification scheme will usually have these same items (or elements) arranged in a hierarchical ordered system based on category-subcategory relationships where the subcategory has the same description as the associated class in addition to one or more descriptions. For example, an apple is a subclass of fruit. So any apple is a fruit, but not every fruit is an apple. A product needs to have a more detailed description to be an “apple” than to be a “fruit”.

3.9 In principle, a classification system can be based on any attribute of the objects being classified. Normally, organising a population of items into categories must leave no two categories with any item in common, in other words the categories must be mutually exclusive. Also, the categories must collectively include all of the items which are in

the population - the categories must be exhaustive. For example, in the case of the CPI, its classification should include the entire universe of goods and services that are covered by the index (for example, fresh food purchased in a store by a consumer is part of the CPI, while heavy machinery such as a tractor is not) and no product should be included in two different classes in the structure.

The CPI classification system

3.10 This section examines more closely the classification process for the CPI. In the particular case of the CPI, the classification can best be described as how the basket of goods and services is divided into its different constituent elements. It also provides a framework for arranging the data in an accurate and systematic manner according to a common set of rules and guidelines. Furthermore, a good classification scheme for the CPI lets the compiler organise its components into various meaningful categories, which facilitates the compilation of the index and is useful for analysis and interpretation of the results by enabling the production of relevant sub-indices such as a goods price index and a services price index or a CPI excluding fresh food and energy.

3.11 In practice, the principles used to classify a domain of objects will depend upon the nature of the objects themselves. For example: individuals or individual households might decide to classify their expenditure into expensive items and cheaper items as an aid to budgeting; policymakers might need products grouped by country of origin or according to their contribution to the inflationary process; and researchers might find it beneficial to have goods identified as durable or non-durable. In the end, there is a multitude of different approaches that can be used for classifying the expenditures and prices on goods and services that are within the domain of the CPI. Three of the more popular approaches for aggregating goods and services are listed in paragraph 3.147 of the CPI Manual and are summarised here.

- According to the *purpose* they serve. Bread can be classified according to its purpose in providing nourishment and thus be located in a category called “Food”. This is the approach used in higher levels of the COICOP classification.
- According to *product type*. Products can be grouped according either to their physical characteristics, the nature of the economic activity that produced them, the production process from which they originated, the type of outlet they are sold from, or where they originated. Take for example rolls of aluminium foil and aluminium foil containers, both of which could be classified under a heading “Household aluminium products”. Clearly these two products share many similarities while their purposes could be quite different.
- According to *economic criteria* where such aspects as: degree of substitutability, degree of complementarity, sales tax applicability, and country of origin could be the defining factors behind the classification. For example, different varieties of apple (because they are close substitutes) could be classified into a category called “Apples” whereas mobile phones and their accessories (because they are complements) could be classified into a group called “Mobile phones and related products”.

3.12 COICOP, as its name implies, is founded on the principle of “purpose”. Paragraphs 3.162-168 of the CPI Manual describe the structure of COICOP in some detail. It is a purpose-type classification because at the higher end of the aggregation scheme the products are grouped according to the purpose (or function) they usually fulfil such as transport, nourishment, shelter, etc. Most national CPIs aim at measuring the change of the cost of a basket of goods and services, which is consumed for the purpose of satisfying certain needs. A purpose-based classification would therefore appear to be the logical classification system for a CPI.

3.13 It must be emphasised that it is at the highest level of the CPI classification that the products are grouped according to purpose. Households will, however, select various goods and services in order to satisfy their consumption objectives (i.e. renting an apartment for the provision of shelter or eating an apple for the purpose of nourishment). These goods and services are aggregated into various groups not based on the principle of purpose but according to product-type. For example, oranges and apples are included in the “Fruit” category. The latter is a product-type classification because these items share a similar production process and are certainly sold at fruit stands or the same location in the supermarket.

Specific requirements of a CPI classification

3.14 Since a CPI is compiled essentially from data on prices and expenditure weights, the same classification should be used for both. In most countries, the basic source of expenditure weights is

the Household Budget Survey (HBS). The use of a common classification between the source of CPI weights (usually the HBS) and the CPI itself will make the process of calculating CPI expenditure weights a more efficient and transparent process and can improve accuracy. The classification used in the HBS should make it possible to assign accurate weights to the most detailed level in the CPI for which weights are required. The notion of "purpose" can provide insights as to where to classify certain expenditures. For example, purchases of fresh meat from an ordinary butcher for the purpose of pet food should be classified in the HBS as "pet food" rather than "food". In COICOP, this would mean allocating it to class 09.3.4 rather than class 01.1.2.

3.15 As stated in the introduction to this chapter, the CPI Manual presents three criteria that should be considered when developing a CPI classification system.

- The classification must reflect current economic reality.
- The needs of users for information below the all-items CPI should be given a high priority when elaborating the classification.
- The categories that make up the classification should cover all the goods and services considered within scope of the CPI and should be mutually exclusive.

3.16 At a practical level, the compilation of the index requires that data be first collected at the lowest level and then aggregated up to the highest level (the all-items CPI) in the order presented by the aggregation scheme. In other words, the compilation exercise of the CPI is bottom-up. However, in a typical CPI classification, such as COICOP, the structure is best described as a top-down hierarchical approach, starting with the all-items CPI, all the way down to the detailed specifications for the representative items selected for price collection.

3.17 The classification should be structured in such a way that "new" products (new variants of existing products and genuinely new goods and services) can be easily accommodated in the index while minimising the need to disrupt the continuity of the series, at least at the higher levels of aggregation. This is a particularly important issue given that new products are continuously being introduced in the marketplace. The CPI needs to reflect this reality by accommodating the price observations for these items in its compilation when the expenditures become significant enough. The latter is dealt with towards the end of this chapter. The wider issue of dealing with new products is dealt with in Chapter 8 of this Handbook. The overriding point that needs to be made here is that the COICOP structure permits the incorporation of new products within any of the Class levels, without the need for creating a new Class and thereby changing the COICOP structure.

The COICOP classification

3.18 COICOP is the taxonomy for classifying consumer expenditures and prices on goods and services by purpose. The units of classification are, however, the expenditures and prices, associated with the acquisition by households of specific goods and services; it is not in practice the expenditures on "purposes". By viewing the classification scheme of COICOP, it is clear that the top level, the Divisions, are groupings that reflect purposes; the third level, Classes, presents the aggregations as product-types, and the second level has elements of both. Hence, a COICOP-based CPI uses a classification scheme that can more accurately be described as mixed (purpose and product-type) as opposed to just purpose-based, but the basic building blocks at the higher level relate to purpose.

3.19 The highest level of COICOP is the DIVISION level, of which there are 12 (Food and non-alcoholic beverages, Alcoholic beverages, Tobacco and narcotics, Clothing and footwear, etc). Within the Divisions are GROUPS, of which there are 47. Thus, in Division 11 (Restaurants and hotels) there are 2 Groups: Catering services and Accommodation services. Finally, each Group is divided into CLASSES, of which there are 117. Thus, in Group 03.2 (Footwear) there are 2 Classes: Shoes and other footwear, and Repair and hire of footwear. The class level is often referred to as the "4th digit" level of COICOP. Thus the latter class has the code 03.2.2, containing 4 digits. But it should be borne in mind that despite the 4 digits there are in fact only 3 levels of disaggregation below the all-items level.

3.20 All COICOP classes are classified as "services" (S), "non-durables" (ND), "semi-durables" (SD) or "durables" (D). This supplementary dimension to the classification scheme provides additional information for research and analysis, for example in estimating the stock of "capital goods" held by households or for analysing the source of inflationary pressures in the economy, for example goods inflation versus services inflation.

3.21 Some classes contain both goods and services because a breakdown is not practical or even feasible. By convention, these classes are usually assigned an (S) as the service component is considered to be predominant. For example, a restaurant meal is a tangible product but is

categorised as a service because a significant portion of its value added comprises the preparation of the meal and other services. Similarly there are classes which contain either both non-durable and semi-durable goods or both semi-durable and durable goods. Again, such classes are assigned an (ND), (SD) or (D) according to which type of good is considered to be the most important.

3.22 COICOP fulfils the essential requirements of a CPI classification as described in paragraphs 3.162 to 3.168 of the CPI Manual. The basic structure reflects current patterns of consumption and, given that it allows countries to add further detail at sub-class level, it fulfils the requirement for reflecting market realities and for providing the facility to incorporate new or local products. The hierarchic structure can be used to define the levels of sub-indices which are to be published. Moreover, the use of the S, ND, and D classifications permits the presentation of results in ways useful for analysts.

Benefits of adopting the COICOP classification

3.23 COICOP has become the *de facto* international standard for CPI classifications, in line with the requirement of SNA 2008 to use COICOP in the national accounts. For purposes of international comparisons of inflation at any level below the all-items CPI, a standard classification is necessary, and it is for this reason that the ILO resolution recommends the use of COICOP, particularly for international comparability. At the national level, countries need to make comparisons of their own inflation performance at different levels of detail, and to do this accurately their own classification needs to be comparable with those in the comparison countries.

3.24 For specific international comparison projects such as the ICP, a standard classification of household consumption expenditure is needed, and again COICOP has been chosen for this project.

3.25 In the European Union, Harmonised Indices of Consumer Prices (HICPs) have been developed to allow inflation to be measured in a consistent way throughout all the member states. COICOP is used as the basis of classification in all countries, as each sub-index must be defined in a comparable way.

3.26 There are clear benefits in terms of less confusion for users by having the same classification scheme for as many as possible of a country's economic statistics.

National versions of COICOP at the sub-class level

3.27 The most detailed level of COICOP is the Class level (4 digits). This is almost always too broad for CPI sampling purposes, which require not only well-specified items for price collection but also the grouping of products for which weights are not normally available into elementary aggregates. The published list of products covered by each COICOP Class level should provide sufficient information to enable the CPI compiler to create sub-classes and "micro-classes (groupings below the sub-class level), which are relevant to the products available in the national market. In defining the sub-classes and micro-classes, CPI compilers should refer to other international classifications such as CPA[2], CPC[3] and ISIC[4], which may suggest useful groupings at these detailed levels – useful in the sense that analysts may be able to use the data in conjunction with other economic data based on similar classifications. But these are not designed for the purpose of a CPI and as a result the classifications do not fit neatly into patterns of consumer expenditure. More detailed groupings may also be useful for sampling purposes in the compilation of the CPI.

3.28 The following principles should be used for the purpose of defining a sub-class independent of the classification system.

- The sub-class should have a clear and economically meaningful content.
- It should account for a significant share of the CPI basket.
- Taken individually, the calculated price index at the sub-class level should generate analytical value and interest to the various types of user.
- The weights data and the quality and size of the price sample should generate price indices at the sub-class level of acceptable statistical reliability.

3.29 These points can be contradictory. Users may need, say, a price index for imported beers (third point) but for reasons of statistical reliability (fourth

[2] Classification of Products by Activity: see http://unstats.un.org/unsd/class/family/family2.asp?Cl=217. http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=236&Lg=1

[3] Central Product Classification: see http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1

[4] International Standard Industrial Classification of all Economic Activities: see: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27 http://www.eclac.org/deype/noticias/noticias/9/20899/ISIC4-040512.pdf

point) a price index only for beer (domestic and imported) is of publishable or reliable quality.

3.30 Note that items that are not explicitly included are nevertheless included implicitly, often in a category defined as "other" - such as "other dairy products". This approach ensures that the CPI will be exhaustive and all-inclusive of the products within scope of the index. Note also that prices need not necessarily be collected for these "catch-all" categories as such. They can be imputed from the movements of prices of similar products for which prices are collected. Moreover, the indices for these "other" products do not necessarily need to be published because they may provide little value to users.

Incorporating new products in the CPI classification

3.31 The scope of COICOP is wide enough to incorporate any type of new product that could be imagined. Even in services, where it is possible to imagine new services that have not yet been thought of, there exists Class 12.7 "Other services not elsewhere classified". It is very unlikely that during the lifetime of the current version of COICOP a new good will arise which cannot be included in one of the COICOP classes. Of course, it is possible that new goods or services will arise which are not listed in the examples shown in COICOP. But in these cases it is the task of the CPI compiler to allocate the product to an appropriate class. In some cases, especially the type of "revolutionary" new product discussed in Chapter 8 of the Manual, it will be necessary for the compiler to create a new sub-class, such as telephone internet services within Class 08.3.0. Close liaison with other compilers will reduce the risk of incompatible treatments by different countries.

3.32 The techniques for incorporating a new product in the CPI are discussed fully in Chapter 8 of this Handbook and are not repeated here. Suffice it to note that new goods should be incorporated into the CPI, in the appropriate part of the classification, when their market share reaches a certain pre-defined level where exclusion would undermine the accuracy of the published indices.

Changing from a national classification to COICOP

3.33 Adopting a new classification system based on COICOP, or simply modifying an existing one, is not without its potential drawbacks. The most serious one, which is always an issue for economic time series when there is a major structural change, is the resultant break in historical continuity. Clearly, when a classification system such as the one used for the CPI is reorganised, the time series of many of its constituent parts is disrupted.

3.34 Compromises to the historical continuity of the CPI and its components are often mentioned as the overriding factor when deciding not to change the classification system. Many countries have, however, successfully reconstructed retrospective (or back-cast) indices after switching to a new classification system although this can sometime result in revisions to higher-level indices and the all-items CPI caused by issues of rounding. Unavoidably, some compromises may need to be made. It may not be possible for a country's old classification system to map cleanly into the new one and some adjustments may have to be made. For example, the U.S. has produced an "analytical" COICOP-based CPI extending back to 1997. Because of mapping difficulties at the lower levels of aggregation between the U.S. and COICOP classifications, the series could be reconstructed on a consistent basis only at the COICOP Division level. Likewise, all European Union countries have made reconstructions of the HICP at the 4-digit level back to 1996. It is easier to make such reconstructions in countries where COICOP was introduced in the national accounts, Household Budget Surveys and CPI at approximately the same time.

CHAPTER 4

Expenditure Weights in the CPI

Introduction

4.1 A CPI measures changes in the cost of a representative basket of goods and services. This involves weighting together aggregated prices for different categories of goods and services so that each takes an appropriate share to reflect the budgets of the household covered by the index. For instance, if most people spend far more on fresh vegetables than on electricity then a price rise for fresh vegetables must have more effect on overall price rises than a similar-sized increase for electricity. At the lowest level therefore, each elementary aggregate (see Chapter 10) should receive a weight equal to the ratio of expenditure by index households on goods and services represented by that aggregate to all expenditure by index households on items within the scope of the CPI.

4.2 Chapter 4 of the CPI Manual discusses the derivation and sources of the expenditure weights. More detailed guidance on specific issues is also given, including:

- Data sources (paragraphs 1.191 to 1.199)
- Geographical coverage (paragraphs 3.97 to 3.104)
- Price updating (paragraphs 1.17 to 1.20, 1.28 to 1.29, and 9.95 to 9.104)
- Seasonal products (paragraphs 4.63 to 4.66).

4.3 Paragraph 19 of the 2003 ILO Resolution on CPIs makes the obvious but important point that the weights follow directly from the scope of the index as well as from the choice between the "acquisition", "use" or "payment" approach and, paragraph 23, that there are two basic sources of information: Household Budget Surveys and National Accounts. It also mentions, in paragraph 25, the possible use of price-updating where the weight reference period falls significantly behind the price reference period and, in paragraph 26, that weights should be reviewed at least every five years.

Background

4.4 Expenditure weights are used to combine elementary price indices to derive higher level aggregations up to and including the All Items CPI.

4.5 The three most common ways of expressing the weights are: as shares (or fractions) that sum to unity; as percentages summing to 100; as per mille numbers summing to 1000.

4.6 The use of expenditure weights is consistent in concept with a CPI based on the acquisition, payment and user cost approaches although the treatment of major durable goods and housing can present a problem, particularly the housing costs of owner-occupiers. The use of expenditure weights in a CPI is often referred to as a CPI based on the concept of plutocratic weights and being based on total expenditure this concept gives more weight implicitly to the expenditure patterns of high-spending households (which will also tend to be those with higher incomes).

4.7 The goods and services consumed by the households can in principle be acquired in six ways:

- Purchase in monetary transactions.
- From own production
- As payment in kind
- Social transfers in kind
- Barter
- As transfers or gifts from other economic units

4.8 The weights themselves are determined by the scope of the CPI and should be derived on basis of the relevant coverage and types of consumption and with reference to SNA concepts. The broadest possible scope for goods and services would cover all six of the above categories. It would include all social transfers in kind in the form of education, health and housing and other goods or services provided free of charge or at nominal prices. The total acquisition of goods and services thus described is equivalent to total actual consumption of households in the SNA.

For the CPI as a general measure of inflation the more relevant would be to include only goods and services purchased in monetary transactions by the households. The latter excludes the second, third and forth categories. Only monetary expenditure generates prices that can be observed for the CPI but this then leaves outstanding the issue of owner-occupier housing which is considered in detail in Chapter 9.1.

4.9 It is against this background, that a CPI often follows the concept of "household final monetary consumption expenditure" (HFMCE), the approach often recommended for a CPI being used as a macro-economic indicator, restricted to the appropriate reference population, or "Index Households", where the CPI is being used as a compensation index. The latter might, for example, exclude the very rich[5].

4.10 But it should be noted that the SNA operates with many delineations of consumption. One of them is "household final consumption expenditure" (HFCE) – which includes non-monetary consumption (such as for owner-occupier housing and consumption of own production (food)). HFMCE is certainly a very useful concept but many countries prefer to also include some non-monetary expenditure (in particular owner-occupier housing) in their CPI, sometimes using imputed costs thus moving the coverage of the index closer to HFCE.

4.11 Following the HFMCE approach, the coverage will be consumption expenditure that is incurred in the reference period:

- by households irrespective of nationality or residence status, and
- in monetary transactions[6], and
- in the economic territory of the country, and
- on goods and services for personal consumption by individuals or households.

4.12 The third bullet point is a reference to the domestic concept. The alternative - the National concept - where a CPI covers the non-business expenditure of the resident population of the country, regardless of where the expenditure takes place, is appropriate when a CPI is being used for indexation of incomes.

[5] Note that expenditure weights derived from unadjusted Household Budget Survey results, unless re-weighted for variable response rates, will tend to under-record the expenditure of the wealthier households whose response rates are usually low.

[6] As already mentioned, it can be argued that according to National Accounts principles own-account production should be included. Although in practice this will depend on the purpose of the index and the ability to overcome practical measurement issues.

4.13 The conceptual issues relating to the construction of weights are discussed in more detail below.

Conceptual basis of the weights

Plutocratic or democratic weights?

4.14 This use of aggregated expenditure by index households to derive weights reflects the principle that each index household contributes to the weights an amount proportional to its expenditure. This is sometimes referred to as plutocratic weighting and means that the expenditure patterns of high-spending households (which of course tend to be those with higher incomes) have more influence on the index. The use of plutocratic weights is generally considered more appropriate particularly for consumer price indices which have been constructed to be a general macroeconomic indicator. In principle, it is possible to derive democratic weights, where each household is given equal weight, but these are not considered appropriate for an index used as a general measure of inflation. They are better suited to CPIs which are intended to reflect the inflation experience of the typical household. Even so they are very rarely computed.

Acquisition, use or payment approach?

4.15 The acquisition approach relates to when the good or service is acquired irrespective of when it is actually used or consumed. The total value of all goods and services delivered during a given period, whether or not they were wholly paid for or used during the period, is taken into account in the weights. A CPI based on this approach measures the change in the cost of acquiring a product. The use cost (or consumption) approach relates to the period over which the product is consumed or used; a CPI based on this approach measures the change in the cost of using the product over time; in other words the cost of the good is distributed over its useful life The payment approach relates to the period of time when the actual period-to-period payments for the product are made. This can differ from the period when it is acquired and when it is used. A CPI based on this approach will measure the change in the cost of purchasing a commodity over time. The use of expenditure weights is consistent in concept with all three approaches, although it raises a number of conceptual and practical issues for the use approach particularly in connection with the time dimension. See Chapter 2 for further detail.

4.16 In practice, the choice between the acquisition, use or payment approaches is an issue

relating to durable goods and its practical impact is likely to be limited to the weight given to owner-occupier housing costs. The latter is discussed in Section 9.1 of the Handbook. In countries where food expenditures and other expenditures on non-durables, semi-durables and even services account for a significant share of the CPI basket and where credit financing is rarely if ever used, the acquisition, use and payment approaches will give very similar results and hence the CPI can satisfy many uses equally well. This is the principal reason why most countries use, either implicitly or explicitly, the acquisitions approach to define what constitutes consumption expenditure.

Taxes and subsidies

4.17 Given that the prices collected for the CPI are final prices paid by the purchaser, i.e. inclusive of the impact of all taxes and subsidies, the expenditure weights should also be inclusive of the impact of taxes and subsidies. Thus the weights should be based on the price paid after any general subsidies by government, for instance grants given to operators to subsidise public transport fares, are deducted, and after any taxes such as VAT, are added, i.e. the expenditure weights are based on actual purchase price paid by the consumer. Payments made to particular households to help fund purchases, in the form of, say, additional social security payments, but which are not explicitly related to particular transactions or purchases should not be reflected in the CPI. These transfers are treated as a form of income for CPI purposes.

4.18 This chapter makes the working assumption that the CPI weights are calculated on the basis of the acquisition approach using plutocratic weights based on expenditure inclusive of taxes and subsidies.

Population coverage

4.19 The target or reference populations will be defined depending on the main purpose and use of the index. For example, in some countries the wealthiest households are excluded because their expenditure may be atypical or the Household Budget Survey information may be unreliable because of low response. Thus, some of the products that are consumed exclusively by these households can be costly to collect given the small number of transactions involved. Air fares and packaged holiday tours are a good example, where in many countries only a small number of households actually purchase these services and for which accurate measurement of price change can be costly because of the complex nature of the pricing strategies applied to these products.

4.20 Other countries may exclude the expenditure of the very poor. It is argued that by including the high-income socio-economic group the relevance of the CPI as an indicator of the inflation experience of the majority of the population could be put in question. It is further argued that as a consequence, if the main purpose of the index is that it should be used as a compensation tool, then the compiler should aim for a CPI that excludes the households from the extremes of the income scale. This brings the CPI closer to the concept of democratic weights and is based on the idea that households should be compensated on the basis of the inflation experience of a "typical" household. Of course, it is open to countries to compile supplementary CPIs aimed at measuring the inflation experience of different segments of the population. Many would argue that if a certain subgroup of the population is to be compensated for increases in the cost living, then in principle, expenditure weights should be constructed for this subgroup accepting that this re-enforces the continuation of the current expenditure patterns of the sub-group. Thus, it is sometimes the practice to create a special CPI which relates only to the poorest households. Such an index is sometimes referred to as a "subsistence" CPI. A common practice is also to compile a CPI which excludes both extremes of the income distribution.

Geographical scope

4.21 The geographical coverage may follow one of two alternatives:

- The "domestic" concept where the scope of the CPI (in terms of both prices and weights) extends to the whole economic territory and includes the consumption of foreign residents and visitors. This is most appropriate where the main interest is in the price changes within a country. In reality the expenditure of foreign nationals within the domestic territory may be difficult to measure since not all foreign nationals will be covered by household budget surveys. Foreign resident nationals should be covered in the normal HBS, while special surveys of foreign (non-business) visitors (such as International Passenger Surveys at borders and airports) are usually required to cover the expenditure of overseas tourists.
- The "national" concept where non-residents are excluded from the CPI weights but the consumption of nationals abroad - for example while on holiday - is included. This is particularly appropriate when the CPI is used for indexation

of the incomes and benefits of the national population. Household Budget Surveys are generally capable of identifying nearly all relevant expenditure although it is unlikely that the corresponding prices for goods and services purchased abroad will be measurable. It may be possible to use sub-indices from the "partner" countries' CPIs (adjusted for changes in exchange rates).

4.22 A uniform approach to geographical scope is particularly important where harmonized indices are being compiled for like-for-like international comparisons. In countries where the aim is to produce a harmonized price index among neighbouring countries it is important that they all use the same concept to avoid the risk of measurement gaps or double counting.

4.23 The same principles apply when regional indices are being compiled within a country.

Institutional Households

4.24 Institutional households refer to people living permanently in an institution or who may be expected to reside in an institution for a very long time, such as:

- Members of religious orders living in monasteries or convents.
- Long-term patients in hospitals.
- Prisoners serving a long sentence.
- The elderly living in retirement homes.
- Military personnel living in barracks.
- Temporary construction workers living in special quarters.

4.25 Such people are treated as belonging to an institutional household when they have little or no autonomy of action or decision in economic matters. Neither the CPI Manual nor the ILO Resolution is prescriptive about whether a CPI should cover the expenditure of people living in institutional households. Many countries exclude such expenditure in their CPI because of the difficulty of obtaining reliable expenditure information, or because the expenditure associated with such households is unlikely to be very significant in comparison with non-institutional households.

Business expenditure

4.26 Business related expenditures are explicitly excluded from the scope of a CPI. Households may engage in business activities from their home whereby part of the expenditures for some products such as heating and lighting are used partly to operate the business and partly for household consumption. For example, take the case of a subsistence farmer who receives a monthly statement from the electric company; part of the invoiced amount was used to light the stable or operate the machinery while the remainder of the invoice reflects the expenditures incurred for lighting the house and operating home appliances. Only the portion that is used for household consumption should be included in the CPI weights.

4.27 Where household activities overlap with business activities, another complicating issue occurs with the purchase of some durable goods such as cars. In some households the same car can be used as private final consumption or can be considered as gross fixed capital formation (i.e. part of business expenditure). This would be the case when a car is used to provide a taxi service and is also used as the household's main (or secondary) mode of transport. In this case, and assuming that the acquisitions approach to consumption is used for defining consumption for the CPI, the expenditure for the automobile should be allocated between gross fixed capital formation and household consumption on a pro rata basis. In other words, if the household estimates that the car is used 60 percent of the time for business purposes, then the weight used for the CPI should be based on the balance (40 percent) of the purchase price of the automobile.

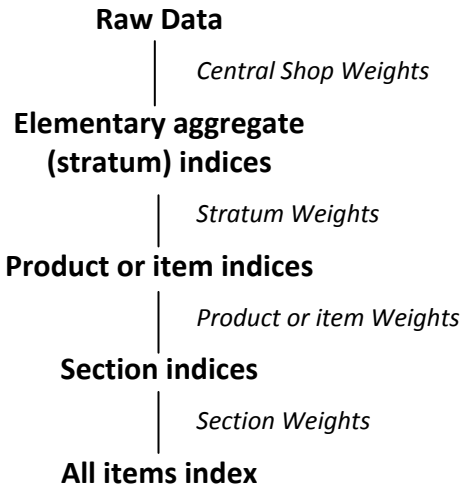
Own-account production

4.28 Own-account production is treated by some countries as within the scope of the CPI, and in other countries as out of scope. It can be argued that while it is definitely part of GDP (which values consumption regardless of its market mechanism) and should therefore be included to achieve consistency with national accounts and for the purpose of producing deflators, it is not necessarily appropriate for a general CPI or a CPI used for indexation where the narrowest concept of consumption that can be used is based on monetary expenditure. Own-account production can account for a significant portion of a country's household consumption. This issue is discussed at length in the CPI Manual (paragraphs 3.74 to 3.89). In some developing countries over 90 percent of households report some own-account production, most frequently with respect to food. Own account production is covered in Chapter 9 of this Handbook.

In-kind remuneration

4.29 If the CPI follows national accounts principles, in-kind remuneration from an employer (the regular

Figure 4.1 Aggregation Procedure



provision of goods or services in exchange for labour services rendered, often operating as part of a contract of employment) is part of the compensation of employees and should be viewed as out-of-scope of the CPI. But there are different interpretations and choices clearly depend on the use of the index. One interpretation, for example, is that all subsidised travel should be excluded from the CPI on principle. Another interpretation is that the value of free travel for, for example, railway workers should not be included in the CPI. But where fares are partially subsidised by the employer the CPI expenditure weights should reflect that element of the fare paid by the employee in the base period and the price index should only reflect changes in the fare tariff and not changes in the level of subsidy arising from changes in the employee's remuneration package, this interpretation is contrary to SNA recommendations.

4.30 As indicated, complications make operation of the above rule far from clear cut. For example, take again the case of subsidised travel for railway workers. It is argued that the value of free or subsidised travel should not be reflected in the CPI. But if persons within the CPI population group receive subsidised travel for the satisfaction of their own personal wants[7], it can be argued, especially for a compensation index, i.e. an index purporting to be a cost-of living index, that the price they pay should, as a matter of principle, be reflected in the CPI as this, to them, is the purchase price. A subsidy to employees is just one of many ways in which the price of a commodity can vary. It is, in effect, a form of discount offered to a special group of consumers. And, just like other discounts which may vary both in terms of the groups to which they apply and in terms of level, the terms of subsidies to employees may vary over time. However, as already indicated, it is more debatable whether these changes in the terms of the discount should be reflected in the CPI. Some argue that the changes in terms should not be reflected in the CPI and that where fares are partially subsidised by the employer the CPI expenditure weights should reflect that element of the fare paid by the employee in the base period and the price index should only reflect changes in the fare tariff and not changes in the level of subsidy arising from changes in the employees remuneration package. Given the conceptual issues and the measurement problems, subsidised fares are often excluded because of the measurement difficulties which arise. Exclusion is not necessarily a matter of principle.

[7] Two forms of 'free or subsidised travel' for transport employees should be distinguished:

- Operational travel - when the primary reason for the travel is the operational convenience of the employer, the cost of the travel is attributable to the operation of the enterprise and is conceptually out of scope of the CPI. The tax treatment of expenditures may help distinguish personal and work expenses. For instance, in some countries for tax purposes a daily commute is in most cases regarded as a personal expense of the employee and is within scope. However, if the travel can be related to the operational needs of the employer – e.g. a tradesman is expected to travel directly to a building site or to the location of his first service call - and the cost is met by the employee, the tax office will often allow the travel expense as a work deduction. By extension, if an airline chooses to deploy staff in a different city to the one in which they live, and the airline provides that employee with free or subsidised daily transport, such travel should fall outside the scope of the CPI because it s not household consumption but is, in effect, an intermediate consumption of the airline.
- Personal travel - when the primary purpose of the travel is for the satisfaction of the wants of the employee (for example, if the employee is involved in recreational travel or a regular commute). Such travel is conceptually within the scope of the CPI, even if it is heavily subsidised (or free).

4.31 A good or service given without reciprocal services being rendered, referred to in the national accounts as a transfer, is out-of-scope of a CPI as there is no transaction or payment involved.

Second-hand goods

4.32 In principle second-hand goods are in scope. A net approach (expenditures minus receipts from sales) is normally used to estimate weights. Most transactions are limited to the household sector and typically cancel out (sales of second-hand goods are negative expenditures) unless the transaction is through a dealer (e.g. used car dealer) in which case the difference would be the dealer's margin and represents the price charged for providing the service of selling second-hand goods. A significant number of countries import second-hand goods and the expenditure on these should be included in the CPI. Chapter 9 of this Handbook gives more detail.

Weighting structure

4.33 The weighting structure should follow the aggregation structure of the CPI. For instance, if the latter is based on The Classification of Individual Consumption According to Purpose (COICOP) then this is the structure which should be used for the weights.

4.34 Additional sub-divisions can be introduced where there is further stratification of the sample to include geographical location, outlet type or a more detailed product level classification. Thus the weighting structure will depend on the sample design for price collection and compilation and in particularly the need for more detailed weights which may be generated by additional sample stratification. In general, national statistics institutes will collect some prices centrally and adopt up to four levels of sampling stratification for local price collection: locations; outlets within locations; items within different sections of expenditure; and product varieties. The latter is normally conducted in the field by price collectors and does not normally involve explicit weights (see Chapter 6). Stratification is frequently used to increase sampling efficiency, especially where the retail market is heterogeneous (see chapter 5), and also operational efficiency. Figure 4.1 illustrates the case where there are:

- *Central shops weights* to represent a small number of large super-market chains or chain stores which have uniform prices across branches and prices are provided by the shops' Head Offices.
- *Stratum weights*. For some types of expenditure, purchasing patterns may differ markedly by region or type of outlet and in these cases stratification will improve the accuracy of item indices. For example, each locally collected item in the index could be allocated to one of the different stratum types to allow the best available information about purchasing patterns to be incorporated in the index calculation. Depending on the structure of the retail market, the stratum types could be: region and shop type; region only; shop type only; and no stratification. The assignment of stratum type will depend on the information available for constructing the weights for each item and the number of prices collected per item. In principle, all locally collected items would be stratified by both region and shop type, but if the weights data are unreliable or non-existent, then the item may be allocated to another stratum type. Allocation also partly depends on which shop types are specified for the collection of prices and the number of prices collected. If the rules for the choice of outlets did not specify that both a multiple and an independent should be chosen for an item, there may be too few prices collected in one of these shop types to make stratification by shop type meaningful. In some instances, there may be no stratification because research has shown that stratification has little effect.

The weight of an elementary aggregate, i.e. the stratum weight, should reflect the expenditure on the entire elementary aggregate and not the weights of the outlets and items that have been chosen to represent it. Therefore, if spaghetti is chosen as the representative product under the elementary aggregate with the heading of pasta products, then the weight of this category should reflect expenditures for all pasta products and not solely the "lower" weight of spaghetti, i.e. the weight of the pasta category will be represented entirely by spaghetti. Similarly, if an expenditure category is divided into two elementary aggregates according to outlet type, say, open markets and supermarkets, with corresponding market shares of food sales, 70 percent and 30 percent respectively, then the same rule as above should apply. For instance, suppose a single store is selected as the representative outlet for a particular food item sold in supermarkets in a country where two supermarket chains have equal sales, then the sales from the sampled store will account for the total value of the expenditure weight of 30 percent; the weight of the elementary aggregate for this food item sold in supermarkets should not be 15 percent (0.30

x 0.50) i.e. a weight based only on the sales of the selected supermarket.

- *Product or item weights (in the current context the terms can be interchangeable).* Some products or items may be intended only to represent themselves; others represent a subclass of expenditure within a section. For instance, within electrical appliances, an electric cooker may represent only itself and not any other kinds of electrical appliances. However, other products or items will represent price changes for a set of products or items, which are not all priced, so for these the weight reflects total expenditure on all products or items in the set. For example, a screwdriver may be one of several items representing all spending on small tools within home improvement and maintenance materials, and there are other items within the section representing all spending on paint, timber, fittings and so on. Some items, such as fresh fruit and vegetables, have "seasonal" weights that vary over the year. These are covered in Chapter 9 of this Handbook.

- *Section weights*. It is common practice to give each section an integer weight in parts per thousand or per hundred so that the sum of the section weights is 1000 or 100. It is likely that most of these weights will be based on the HBS results. The main exceptions will be some housing sections, including (where applicable) mortgage interest payments and depreciation, where weights are estimated from other sources (again see Chapter 9), and for certain other sections (tobacco, confectionery, soft drinks and alcoholic drinks) where the HBS may be thought to under-record expenditure and better data are available elsewhere.

Implicit weights within elementary aggregates

4.35 An un-weighted formula (e.g. Jevons or Dutot – see Chapter 10) is usually used when aggregating the individual price relatives of the sample of products at the elementary aggregate level. This practice is usually justified on the grounds that the required information such as market shares is simply not available to a sufficient level of precision. However, if broad-based estimates of market shares are available, then these can be used as implicit weights for determining the sample of price observations to enhance the accuracy of the elementary price index. Some possible sources for this information are trade publications, market reports, and consultation with industry experts.

4.36 The sample of price observations based on implicit weights can be updated independently and more frequently than the weights of the elementary aggregate but the price statistician will need to ensure that the weights are both coherent and consistent within the elementary aggregate. It is best to review them at the time of updating the basket.

Weights for products for which prices are not collected

4.37 As it is not feasible to collect a full set of prices from every outlet, including market stalls and street vendors, and from every provider of a service, most prices have to be sampled. This means that in practice there will be some products which consumers spend money on for which prices will not be collected (see Chapter 5). But the expenditures for these products need to be included in the expenditure weights. There are two ways of doing this:

- Including the weight in a related elementary aggregate (this may involve the creation of a "miscellaneous" category). But note that it is desirable to make the elementary aggregates as homogeneous as possible. The price movement of the other products within the elementary aggregate become the source for the imputation of prices for the non-priced product. For example, assume an elementary aggregate called "milk and cheese" and that it has been decided that because of the small share of cheese consumption in the country no prices will be collected for this product. Then the movement for the elementary aggregate will be determined solely by any observed price changes for the products from which prices are actually collected, in this case milk.

- By having the weight of the product for which no representative prices exist equal to zero. Using the previous example, the weight of the "milk and cheese" index will be reduced by the value of the weight of cheese. Consequently, its weight will be implicitly reallocated to the weights of the other elementary aggregates in the CPI. In effect cheese prices are being imputed by the movement in the price of milk and of the prices in the remaining elementary indices

4.38 In general, the prices for the product for which prices are not collected will be expected to exhibit a similar movement to the other products in the elementary aggregate and the first of the above two methods should be used. The second method may be used where the elementary aggregate is

heterogeneous or the associated price index is not considered very reliable. Because of the negligible size of the weight value involved, the consequence on the overall index will also be negligible whichever method is used.

Data sources

4.39 This section provides an overview of the main data sources for weights with a discussion about some of their advantages and limitations. It should be emphasised that various data sources can often complement each other in establishing more reliable and accurate overall weights. It is in fact often necessary to take advantage of other sources when the data from the main source are incomplete, lack the required level of detail or are of questionable reliability.

4.40 Depending on the population coverage weights for a CPI are derived either from expenditure data, based on estimates drawn from a sample covered in the Household Budget survey or from national accounts estimates of household consumption expenditure. It should be emphasised, however, that expenditure estimates in the national accounts are themselves partially based on HBS information, although they may differ in terms of coverage, so the two sources are not entirely independent. Note also that national accounts data may also be used when the HBS is conducted too infrequently to ensure the reliability of the CPI or when the expenditure weights need to be updated more often than the periodicity of the HBS. Nevertheless, an HBS will still have to be eventually conducted because it is an important source for benchmarking the components of personal consumption expenditures of the national accounts. Other sources for the weights are also available and are usually complementary to these two main sources. These include tax revenue returns and retail production and sales data. These are discussed later in this chapter.

4.41 When various sources of information are used for generating the weights in a CPI, the compiler should take the time to check the data to ensure that the results are consistent and plausible with what is expected a priori.

Household Budget Surveys

4.42 As a general rule of thumb, the sample size (number of households) for the Household Budget Survey when used for the purpose of the CPI should be such that the expenditure data yielded are able to ensure statistically reliable weights at the elementary aggregate level. In some countries the acceptable statistical quality is based on the coefficient of variation (the ratio of the standard deviation to the mean).

4.43 For those expenditure weights that are unable to meet the minimum requirement of reliability, three options should be considered:

- Combine the elementary aggregate that has the problem weight with another related one to form a new broader elementary aggregate (e.g. “white bread” could be combined with “brown bread” to form a new category called “bread)”. This approach will often lead to a more reliable elementary aggregate but may require an adjustment to the existing structure of the CPI.
- If annual HBS data are available, then expenditures could be averaged over more than one year thus improving the statistical reliability of the data, in terms of standard errors, but to the detriment of timeliness. It should also be noted that averaging may not improve the statistical quality of the expenditure estimates if a particular category of household expenditure is rapidly growing or declining. Averaging is useful if the particular expenditure category under consideration shows a lot of variability over several budget surveys but no clear trend. This is an area where the statistician will have to use his or her judgement. The “price-updating” of weights, described later on in this chapter, is sometimes used to overcome the latter difficulty. Using multi-year expenditure data can also reduce the risk of having unrepresentative weights for the base period. Average expenditures over a span of three years, for instance, will usually yield representative estimates of the basket shares for the base period but again, the compiler has to consider the dynamic parts of the market where there are rapid increases or declines in the use of the expenditure category. If resource availability is an issue, then a less ambitious household budget survey which generates multi-year weights only for one category of commodities, such as for the food category, may be considered. The basket reference period should not be arbitrarily chosen and periods of less than a year should be avoided because of seasonal influences on consumption patterns. Furthermore, some countries exclude, from multi-year averages, years which are exceptional, e.g. as a result of particularly poor harvests leading to high prices.
- Leave the CPI structure unchanged and simply accept that the weight for the particular

elementary aggregate concerned is of doubtful quality. Whether this is an acceptable position to take will depend on the weight of the elementary aggregate and on its importance, particularly to analysts For example it would be a difficult position to sustain if the elementary aggregate has a large weight and is presented as a published sub-index.

4.44 It should be noted that in normal circumstances weights can tolerate a certain degree of imprecision before having a significant effect on the overall CPI, particularly at the higher levels of aggregation, or main divisions of the CPI. But this is less so at lower levels. For instance, take an index described as "fruits and vegetables" where with a biased estimate of the expenditure weights, fruits account for 60% of the index and vegetables the remaining 40%. This biased fruit category will not only influence this product's weight but will compound itself by affecting also the relative importance of vegetables in the basket, i.e. if the true weight for fruit is 40%, then residually the weight of vegetables will be 60%, not 40%. Consequently, the price index for "fruits and vegetables" will be also biased. To minimize the potential for such occurrences, it is recommended that the compiler always strives to get the best possible estimates for the expenditure weights.

4.45 An annual HBS is optimal for a CPI because as well as avoiding one-off set-up costs, it permits the annual updating of the weights hence reducing the substitution bias associated with out-of-date weights in a fixed-basket index like the CPI. Furthermore, it provides the opportunity for using multi-year weights to reduce the sampling error and, where considered appropriate, minimise the sampling variance associated with unusual expenditure patterns in a particular year (for instance, abnormal circumstances affecting consumer behaviour such as political events, natural disasters, or oil shocks). But obtaining reliable consumption estimates is challenging and there is a persistent trade-off between data quality and survey cost.

4.46 The following outlines some of the advantages and disadvantages associated with using the HBS as the main source of weight data for the CPI.

Advantages of the Household Budget Survey

4.47 The HBS can be tailored to the particular needs of the CPI so that the information obtained maps directly into the CPI classification system and targets the precise reference population. The HBS is designed to cover only consumer expenditures and is less likely to accidentally pick up business expenditures.

4.48 The HBS can theoretically provide information on regional breakdowns of expenditures and hence the weight data by geographical stratification.

4.49 The HBS provides data about household characteristics such as income and number of members. This is useful for ensuring that the expenditures correspond to those of the CPI reference population and can also be used for producing CPIs for different population sub-groups.

4.50 Depending on its design, the HBS may be able to provide information on the types of outlet where purchases are made and the brands purchased. This information can be used to construct elementary aggregates at a finer level of detail and to improve the sample design for shops and items for price collection. But it should be borne in mind that the HBS places a heavy burden on respondents and as a result can suffer from non-response. Extending the HBS with further questions may make this problem worse.

4.51 Given that most HBS's are probabilistic samples, statistical quality indicators (e.g. standard error and coefficient of variation) for the weights can be calculated. Such information can provide the index compiler with some direction on the structure of the elementary aggregates. If an analysis of the HBS shows, for example, that the expenditure data for lemons is of poor statistical quality, then a more broadly defined elementary aggregate such as citrus fruit could be considered instead.

Disadvantages of the Household Budget Survey

4.52 HBS's are resource intensive and costly. They also impose a significant burden on respondents which may have an impact on response rates and on the quality of information received. Estimates from an HBS are prone to measurement error, potentially leading to biased results and inaccurate weights data. This is especially true of recall surveys, which are widely used in developing countries. Of relevance to the construction of CPI weights are errors associated with:

- Prestige (under- or over-reporting associated with the prestige of an item).
- Telescoping (incorrect placing of an expenditure in time by respondent). Telescoping usually affects non-routine and infrequent purchases such as books or furniture. This error can bias the results either upward or downward.

- Recall (failure to recall an earlier expenditure, associated with recall decay, due to the time lapse between purchase and reporting date). This is often associated with under-reporting.

4.53 These problems have been overcome in some smaller countries by using a methodology based on a sample survey of people's receipts but such a methodology relies on receipts always being issued and is therefore unlikely to be successful in many developing countries.

Under-reporting

4.54 Evidence suggests that the understatement of expenditures can be significant for certain goods and services in the HBS, particularly when associated with "anti-social" behaviour, such as smoking and drinking of alcohol. Recurring events such as the purchase of food items usually suffer also from recall decay. Rents, utility payments and insurance premiums, and purchases of expensive items such as furniture and cars, are not as prone to recall error but are nevertheless still subject to some under-reporting. If there is clear evidence of under-reporting for a certain product, then an alternative source of information, if available, should be used instead. Sometimes a complementary survey using a weekly or bi-weekly diary method and based on an independent sample from the recall sample, is conducted to better capture the smaller, more frequent purchases which respondents have more difficulty recalling. Examples are food, beverages, catering and non-prescription pharmaceuticals. Sub-annual survey findings, whether from a weekly or bi-weekly diary or from a quarterly recall, not only must be grossed-up to population totals but also converted to annual estimates. Data from a regular diary also provides the possibility of creating seasonal baskets for the CPI.

4.55 If the under-reporting problem persists, then the HBS expenditure estimates can be compared with other data sources (e.g. tax data, other independent surveys or consumption expenditures from the national accounts) and correction factors applied. This approach can also be used when certain types of expenditures that are within scope of the CPI are missing from the survey. Note that a special adjustment may not be justified where the under-reporting is due to recall error. As the latter is inherent to the findings for many other products, the bias may cancel out - all other things being equal. Adjusting for under-reporting is a matter of judgement.

4.56 It must be emphasised that these alternative sources are not always perfectly comparable with the coverage of the CPI and may suffer from their own errors. For example, data on alcohol sales from excise tax revenue information are likely to include sales to restaurants and businesses. Often adjustments have to be made to the alternative data source when comparing these data with the HBS data.

Examples of adjustments for under-reporting

4.57 Tables 4.1 – 4.3 provide an illustrative example of how adjustments for under-reporting can be made to the HBS estimates of expenditure on cigarettes where, for example, the national accounts include estimates of household expenditure on smuggled cigarettes which will not be covered by the HBS as well as total tax revenue from legitimate sales. This could apply equally to alcohol – both products are generally believed to be significantly under-reported in the HBS because, even apart from illegitimate sales, respondents are reluctant to admit to how much they spend as a result of cultural perceptions about the consumption of these products, or, indeed, because of embarrassment within the household.

4.58 To produce the adjustment factor for the cigarette section for 2004 the following calculations would be made.

4.59 First, the annual total of expenditure on cigarettes is calculated by summing four quarters of Household Final Consumption Expenditure (HFCE) data from the National Accounts. For the calculation of 2004 weights, the data from the last two quarters of 2002 and the first two quarters of 2003 are summed (see below). This is so that the data relates to the same period as the HBS data used to calculate the weights for the 2004 CPI.

Table 4.1 National Accounts expenditure data ($ million, current prices)

2002 Q3	2002 Q4	2003 Q1	2003 Q2	ANNUAL TOTAL
3416	3413	3405	3441	13675

4.60 Then from the HBS "all household expenditure" data, the figure for the average weekly expenditure on cigarettes for the year to June 2003 is taken. This is then multiplied by the number of households and the number of weeks in a year to obtain the implied HBS all-household total annual expenditure on cigarettes.

Table 4.2 Expenditure according to HBS

HBS all-household (weekly average, $) Year to June 2003	Number of households (million) 2002	Implied HBS all-household total annual expenditure ($ million)
4.816	25	6278

4.61 To obtain the correction coefficient used to calculate the section weight the ratio of National Accounts to HBS all-household data is calculated.

Table 4.3 Correction factor (year to 30 June 2003)

National Accounts expenditure ($ million, current prices) Annual total	Implied HBS all household total annual expenditure ($ million)	National Accounts expenditure/HBS all household data = correction factor
13675	6278	2.178

4.62 The HBS average weekly expenditure on cigarettes or tobacco index households is therefore multiplied by 2.178.

4.63 Adjusting for under-reporting will impact on all weights, not just those where the under-reporting has been detected. All weights will need to be re-scaled to sum to 100 or 1000.

The commodity flow approach to adjust household expenditure data from an HBS

4.64 This generalised approach uses domestic production and import/export figures obtained from the national accounts to adjust consumption expenditures which have been under or over reported in the Household Budget Survey. Domestic consumption is estimated from domestic production plus imports less exports, the latter including re-exports. Estimates of the proportion of domestic consumption which relates to non-household consumption are then used to estimate household consumption and the latter are compared with the corresponding estimates from the household budget survey to provide conversion factors which can then be applied to HBS expenditure data to adjust the latter for under or over-reporting. The same conversion factors can be used over a number of years if they are known to be stable. The approach is illustrated in Appendix 4.1.

National Accounts

4.65 The use of National Accounts weights ensures consistency and comparability between the CPI and national accounts definitions and classification systems for household consumption, which is an advantage when compiling a CPI as a macro-economic indicator and for use as a deflator.

4.66 National Accounts have two inherent advantages:

- The Household Consumption element of National Accounts is derived mainly from the HBS but national accountants will often use other sources of information before finalising their results, especially in cases where the accuracy of the HBS is in doubt such as where under-reporting is present. The fact that National Accounts go through an additional quality assurance process and re-estimation should increase the reliability of the weights.
- Even if the HBS is updated infrequently, CPI weights can still be updated at regular intervals from national accounts data for higher level aggregates at the division or group level.

4.67 But there are three inherent disadvantages with National Accounts data:

- It is generally only available at the national level so deconstruction of the national accounts data to provide a finer-level of detail or to produce regional expenditure weights may be necessary using other available sources of information. Other data sources include Household Budget Surveys, retail enquiries and administrative data such as statistics on excise duty. National Accounts data can be used to derive weights at the more aggregate level and HBS data can then be applied to the higher aggregates to derive weights at the lower levels of the aggregation scheme. If the expenditure data from the HBS are not viewed as sufficiently detailed to ensure a minimum of acceptable accuracy, or if a demand exists for indices of a finer breakdown (e.g. there is a need for a price index for apples but only expenditures for all fruit can be derived from the HBS), then other potential data sources can be used for disaggregating the expenditures, including surveys on retail sales, point-of-sales surveys, surveys of production, export and import data, and administrative data. Note that some of these sources may also

be used for stratifying expenditures according to sales volumes by retail outlet type and by region. Population censuses can be used to estimate regional weights if there are no better substitute data available on retail sales. The working assumption in this case is that consumption profiles are similar among the regions.

- National accountants apply an element of discretion and judgment when making operational decisions relating to the construction of National Accounts. Some of the details of these decisions are not always readily available to users. Consequently, compilers of the CPI should consult with their national accounts counterparts regularly before using their data for weights in order to ensure that they are consistent with the objectives of the CPI.
- National accounts data are often subject to revision for several years.

Weights reference period

4.68 Most CPIs adopt a Laspeyres-type formulation. This reflects the reality that for most price indices only base period weights are available. In addition, due to the frequency and time taken in collecting the necessary expenditure data, weights often have to be estimated using price-updating. The computational form of the index is described as a Laspeyres-type index, in part, to reflect the fact that it is a weighted aggregation of un-weighted elementary indices. This index has the advantage that it is one of the more transparent of the formulae available and is one of the more easily understood by the users[8].

[8] The Laspeyres formulation measures current prices weighted by base quantities divided by base prices weighted by base quantities. A more detailed discussion is given in Chapter 10.

$$P_{LA} = \frac{\sum_i p_i^t q_i^b}{\sum_i p_i^b q_i^b} = \sum_i \frac{p_i^t}{p_i^b} \times w_i$$

where $w_i = \frac{p_i^b q_i^b}{\sum_i p_i^b q_i^b}$

p_i^b *= Price of item i in the base period*

p_i^t *= Price of item i in period t*

q_i^b *= Quantity of item i sold in the base period*

But strictly speaking CPIs are not really Laspeyres indices; they are Lowe indices, i.e. the reference weights refer to a possibly distant year while the reference month or quarter is more recent. p^0 refers to the reference month whereas w^b refers to the reference year (which is different from the reference month). The common practice amongst index compilers is to price update the weights but this still leaves an inconsistency between the price reference period and the weight reference period.

4.69 The higher-level indices of the CPI are calculated as weighted arithmetic averages of the elementary price indices using the pre-determined expenditure shares of the elementary indices as weights. The calculation formula can be written as follows:

$$P^{t/0} = \sum w_i^b \frac{p_i^t}{p_i^0}, \quad \sum w_i^b = 1$$

where $P^{t/0}$ *denotes the overall CPI, or any higher-level index, from period 0 to t;*

w_j^b *is the weight attached to each of the elementary price indices;*

and p_i^t/p_i^0 *is the corresponding elementary price index.*

The elementary indices are identified by the subscript *i*, whereas the higher-level index carries no subscript. As already noted, a higher-level index is any index, including the overall CPI, above the elementary aggregate level. The weights are derived from expenditures in period *b*, the weight reference period. In practice, the weight reference period has to precede the price reference period because of the time it takes to compile weighting data.

4.70 Some countries revise their weights at the beginning of each year in order to try to approximate as closely as possible to current consumption patterns, but many countries continue to use the same weights for several years. Where the basket is not updated annually, the compiler should guard against choosing a basket reference period where economic conditions are temporarily atypical such as a year where a drought or other adverse events occurred that could have significantly altered the normal pattern of consumption of the population. This is because the estimated weights will .be unlikely to reflect the usual expenditure patterns of the population over the base period. For example, a severe drought may result in temporary price increases for certain food items leading to a marked fall in overall purchases and also of expenditures of those products over, say, a year. Consequently, the relative importance of the item or items in the basket will be lower than it would have otherwise been. Conversely, the expenditure share of the unaffected items will increase for two reasons - on the one hand, it naturally increases because the

affected items now account for a smaller share of total expenditures, all else being equal and on the other hand, it increases as a manifestation of consumers' reaction of shifting their purchases in favour of the items for which the relative price has declined – the "substitution effect". Clearly, the compounded effects of these two influences can potentially lead to serious distortions in the weights, which is not limited to the products that were affected by the adverse event. How significantly the basket shares are distorted will depend on the items' importance in the basket and the magnitude of the distorting effects.

4.71 For some goods or services an average of, say, three years data may be used. This may be the case for items that are purchased infrequently or which are subject to local variations in the weather so that reported expenditure can fluctuate significantly from year to year. Fresh food is an example of a product category for which abnormal circumstances are most likely to occur - a category which carries a large weight in the CPI basket of most countries. The purchase of new cars may be an example of an infrequent but high value purchase. Multi-year weights for fresh food would smooth out the effect of fluctuating expenditure, if this is considered desirable in the CPI. Multi-year weights, at least for cars, are likely to improve the precision of the share estimate for personal transport costs in the basket.

4.72 Whilst the ILO Resolution states that consumer' expenditure patterns in the weighting reference period should be no more than five years old, in reality the weights of the CPI need to be updated with a frequency sufficient to ensure that there is no significant bias from product substitution.

4.73 Clearly a systematic review of weights becomes more pressing when there are rapid changes in consumption patterns (for example, resulting from high inflation, significant changes in disposable income or the introduction of new products or features) or the time from the weight reference period lengthens. In principle, it is recommended that weights should be updated more frequently than every five years and, in particular, that an annual review is carried out of the weights attached to sub-indices and other major components of the CPI. Such a review should examine whether there is evidence of significant changes in consumption patterns.

4.74 If different sources of weights are used, then their reference periods do not necessarily have to be of the same vintage although this is desirable. For example, if the compiler is using national accounts data at the higher levels of aggregation from the most recent year available, say 2006, but the more detailed information needed for deriving the weights at the lower level is only available from an HBS conducted before 2006 then the latter can still be used as a basis for disaggregating the national accounts data. The weights from the HBS may benefit from price updating to ensure a common price reference period for both sources. The practice of price updating the weights is not without controversy and is discussed in the following section.

4.75 When weights are updated, the index using the updated weights needs to be calculated for an overlapping period with the index using the previous weights for the purpose of chain linking. This is usually done in conjunction with a systematic review of the CPI basket of goods and services. A more detailed description of chain linking is given in Chapter 10.

Weight reference periods and price updating

4.76 This section deals with the issue of how to align the weight reference period of expenditure data from national accounts or household budget survey with the price reference period. This is normally done by price-updating the expenditure values, as explained in the following paragraphs, and afterwards using these price-updated values to subdivide the more aggregate weights from national accounts (assuming constant quantities) or by using the expenditure shares from the Household Budget Survey as they stand, without any updating, and using these to subdivide the aggregate national accounts weights (assuming constant expenditure shares). The following explanation in principle relates to the price-updating of weights irrespective of whether these are derived from national accounts or household budget surveys.

4.77 But because of the time lag associated with the collection and compilation of expenditure data, the weights will refer to a period prior to the price reference period of the CPI. Under these circumstances the expenditure weights may be aligned to the price reference period by price-updating the expenditure weights from their reference period to the price reference period. Price-updating is usually applied at the lowest level of aggregation, i.e. at the elementary aggregate level, where each expenditure weight is multiplied by its corresponding elementary index for the period stretching from the weight reference to the price reference periods. The resulting price-updated weights are then rescaled to sum to unity.

4.78 Suppose that the four most recent available quarters of HBS data are used, and are supplied in the form of annual average household expenditure per week. Further suppose that the expenditure weights are to be updated to the 2004 calendar year, with a January base-month, but that the latest HBS data covers the period July 2002 to June 2003. The expenditure values are then re-valued to base-month prices (i.e. January 2004) using the change in the appropriate CPI sub-indices[9]. For example, for calculating the section weights for 2004, HBS annual average data for the period July 2002 to June 2003 - which are centred round January 2003 - are adjusted for the increase in the CPI between January 2003 and January 2004. In the following example, the data are hypothetical.

Average expenditure on goods in section y per week, July 2002-June 2003 = $2.47

Price indices for section y at January 2004 = 101.8 (January 2003 = 100)

Then average expenditure on goods in section y per week after revaluation is:

$$\$2.47 \times \frac{101.8}{100.0} = \$2.51$$

4.79 Then the total expenditure for each section (expressed as a proportion of the total expenditure over all sections within the CPI coverage) is converted into a rounded 'parts-per-1000' weight. Manual adjustment may be needed to make the rounded section weights sum exactly to 1000. Usually, those sections needing the smallest percentage change in expenditure to round a weight up or down to an integer are adjusted.

4.80 For some sections, an average of three years' HBS data may be used rather than one. For instance, the items within these sections may be purchased infrequently so that reported expenditure can fluctuate significantly from year to year, and sampling errors can be very large. By using HBS data from a longer time period, these large fluctuations are reduced.

4.81 A revaluation of a correspondingly longer period will be necessary where expenditure estimates are based on three years of data from the household budget survey to improve reliability of the underlying data, for example where a category of expenditure can fluctuate significantly from one year to the next. This is because the HBS expenditure data will be centred over an earlier period.

4.82 This revaluation should be repeated for each COICOP section and the re-valued expenditure figures are then expressed in terms of parts per thousand of the re-valued total weight, using standard rounding rules to ensure that the weights add up to one thousand.

4.83 The above calculation assumes a price elasticity of substitution of zero. This means that a proportionate increase in the relative price of one category of good does not lead to an offsetting proportionate change in the relative quantity purchased, rather relative expenditures change in proportion to the changes in relative prices. In reality consumers have some discretion over how they spend their money and will tend to purchase relatively smaller quantities of goods that have become relatively more expensive, in other words the elasticity of substitution will be non-zero and in some cases may tend more towards one. The unrealistic assumptions underlying the price updating of weights can result in weights that, compared with the corresponding unadjusted weights, deviate further from the actual weights which subsequently become available. For this reason it is advised that price updating be used with caution. Clearly it is most appropriate for categories of goods where quantities purchased tend not to be over-influenced by price, for example staple foods and other necessities of life.

4.84 Appendix 4.2 presents a more detailed discussion of weight reference periods and of price updating.

Monitoring the quality of the weights

4.85 The precise method of reviewing the weights is a decision for individual statistical offices but it is possible to develop quality control procedures that focus on those relatively few weights that will be critical for the relevance and reliability of the CPI. One possibility is to "test for critical weights" by simulating the impact of an out-of-date weight or an error in a weight on the reliability of the CPI. This will identify those weights which present a significant risk to the reliability of the CPI in terms of their potential to lead to a significant divergence in the movement in the price index from the true movement in the overall CPI over any 12 month period, i.e. the extent to which the corresponding elementary aggregate has an exceptional influence on the published headline CPI.

4.86 The main influencing factors will be relative weight and the extent to which the corresponding

[9] This is an approximation. The HBS data are centred around an average of the two months, December and January. It would be more precise to price-update from the average of December and January. In practice many countries only have and use annual HBS data, as with national accounts.

elementary aggregate is an outlier which influences the published headline CPI.

4.87 In addition, the compiler will need to make a judgement on the likelihood of a weight being out-of date. A view on this will need to take into account such factors as the extent to which the dynamics of the retail market suggest, a priori, that the weights could go out-of-date relatively quickly (for instance, where a new technology, such as mobile telephones, has generated new sales), the size of any divergence in indicative trends in expenditure compared with the rest of the CPI (for example, by extrapolating previous trends and taking into account any recent market intelligence including trends in industrial production or retail sales) and whether prices have changed relative to other goods and services. The compiler will also wish to take a view on whether the price elasticity of demand for a product is likely to be zero or one.

Updating of weights including new volume information

4.88 When new expenditure information becomes available, for example from a recently completed HBS or a more up-to-date set of National Accounts, then the weights can be re-referenced by chaining. Chain linking constructs a continuous price series by multiplying together price indices that have been constructed using different weight reference periods. Chain linking is covered in detail in Chapter 10.

Publication

4.89 For transparency reasons, it is recommended that some weighting data be made available to users. However, the elementary aggregate indices and weights do not necessarily need to be published or released to users. (This is not a criterion for defining an elementary aggregate, although it is often thought so.) There can be issues of confidentiality that will prevent indices at the lower levels of aggregation from being released to users. This would be the case, for example, when an elementary index associated with a product is based on data from only one outlet. Moreover, the compilers may feel that they are able to obtain information about market share which is reliable enough to create, say, strata by outlet-type, but not sufficiently reliable for the corresponding indices to be published.

Appendix 4.1 Example of how the commodity flow approach can be used to adjust the household expenditure data during the computation of CPI weights

ITEM	DOMESTIC PRODUCTION	IMPORTS	EXPORTS	RE-EXPORTS	TOTAL EXPORTS	CONSUMPTION			2005/06 HOUSE HOLD EXP. DATA		CONVERSION FACTORS
						DOMESTIC	NON - HOUSEHOLD	HOUSEHOLD	PER MONTH	FOR A YEAR	
a	b	c	d	e	f=d+e	g=(b+c-f)	h	i=g-h	j	k	l=i/k
Soap	148,187,444,625		12,808,341	20,118	12,828,460	135,358,984,399	13,535,898,440	121,823,085,959	10,017,156	120,205,874,424	1.01
Sugars	1,647,793,730,000	49,055,645	11,643,590	9,747,532	21,391,123	1,675,458,252,044	1,172,820,776,431	502,637,475,613	25,681,735	308,180,825,088	1.63
Tobacco	92,860,273,000	6,812,955	56,058,304		56,058,304	43,614,924	4,361,492,405	39,253,431,647	3,607,513	43,290,160,308	0.91
Beverages	734,682,341,075	11,809,525	12,868,875	133,531	13,002,407	733,489,459,675	73,348,945,968	660,140,513,708	23,611,336	283,336,039,140	2.33
Petroleum		580,418,789	54,150,138	44,296,048	98,446,187	481,972,602,045	337,380,821,432	144,591,780,614	9,825,886	117,910,636,080	1.23

ASSUMPTIONS (these assumptions are for illustrative purposes)

1. Assume 10% of the domestic consumption to be non-household consumption in cases of Soap, Tobacco and Beverages
2. Assume 70% of the domestic consumption to be non-household consumption in cases of Sugar and petroleum products

N.B

1. Situations whereby the conversion factors are close to unity as in case of Soap and Tobacco, no adjustments are made on the Household Expenditure data from the Household Budget Survey (HBS).
2. Commodity Flow approach is not restricted to only known items that are underestimated during the HES such as Tobacco, Beverages and the like
3. Commodity Flow approach is applied to items: (i) Whose weights look to be outliers; (ii) Whose coefficients of variation are substantially high according to the HBS results.
4. Under Beverages, there are four elementary aggregates; Sodas, Mineral Water, Bottled beers and locally brewed beers.

Appendix 4.2 Price reference periods, price updating and the index formulation

4.2.1 In the basic Laspeyres index the price reference period and the weight reference period are identical, namely period *b*.

$$P_{LA}^{t/b} = \frac{\sum_i p_i^t q_i^b}{\sum_i p_i^b q_i^b}$$

$$= \sum_i \frac{p_i^t}{p_i^b} \frac{p_i^b q_i^b}{\sum_i p_i^b q_i^b}$$

$$= \sum_i \frac{p_i^t}{p_i^b} \frac{v^i}{\sum_i v^i}, \sum_i v^i = 1$$

4.2.2 Where $P_{LA}^{t/b}$ denotes the overall Laspeyres price index, or any higher-level index, from period *b* to *t*; v^i is the value weight attached to each of the elementary price indices, *i*, and p_i^t / p_i^b is the corresponding elementary price index from period *b*, to period *t*. Note that the elementary indices are identified by the subscript *i*, whereas the higher-level index carries no subscript. A higher-level index is any index, including the overall CPI, above the elementary aggregate level. The weights are derived from expenditures in period *b*, the weight reference period. Note that all three formulas are algebraically equivalent but the last one defines the index as the expenditure share weighted average of the elementary price indices, and thus reflects the fact that data on the individual quantities, *q*, are typically unavailable, while expenditure information is available to the compiler.

4.2.3 Figure 4.2.1 provides an illustration of the relationship between the various periods involved when calculating price indexes using various formulas. The basket (or weight) reference period is *b*, in other words this is the time period for which the expenditure weights derived from the HBS relate to and the price reference period is *0*. Clearly these two periods differ. *t* represents the current period and *T* is the end-of index link period which is the period when the next new basket will be introduced.

4.2.4 The regular calculation of a CPI will use an approach that differs from the one suggested by the Laspeyres price index formula. This is because the weight reference period, which spans a year, will precede the price reference period, which usually relates to a month (or in some cases a quarter or a year).[10] For example, a monthly CPI may be compiled from January 2009 onward with December 2008 as the price reference month, but the latest available weights may refer to, say, 2006. Consequently, the statistical office will have to exercise the choice of either price-updating the weights from the weight reference period to the price reference period, or use the unadjusted reference period expenditure values.

4.2.5 If the basket is to represent fixed quantities (i.e. the *q*'s) that were determined in the weight reference period (*b*), then it is essential that the expenditures expressed as values for the reference period, be re-valued (or price updated) at those prices prevailing at the link (or price reference) period, *0.*

4.2.6 Price-updating is done by multiplying the elementary aggregate expenditure shares by the development in the corresponding elementary indices from the weight to the price reference period. As a result the weights will change according to the development in the relative prices, while the underlying quantities are, as per the objective, kept constant. The resulting adjusted share weights are rescaled so that they sum to unity (see Chapter 10).

4.2.7 The formula below shows this step and the resulting new price updated weight, w_i (sometimes referred to as the "hybrid" value weight) associated with the elementary aggregate for product *i*. Further discussion on the topic of price updating the weights can be found in chapter 10.

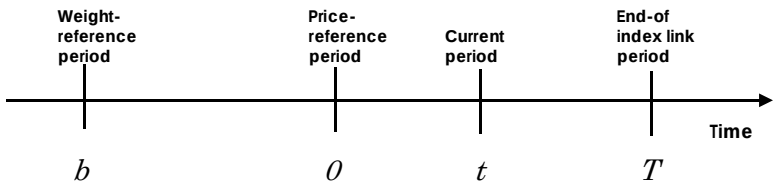
$$w_i = \left(p_i^b q_i^b\right) \times \frac{p_i^0}{p_i^b} = p_i^0 q_i^b$$

Where:

p_i^b*: The price of product i in the basket reference period.*

[10] Note, that an annual basket is used, which helps to minimize seasonality problems as well as to smooth the weights. In addition, because of the time needed for data collection and processing, there is a lag between the reference period of the expenditure data as surveyed from the HBS or derived from the National Accounts and the period when the data are finalised and ready to be introduced as the new weights in the CPI (i.e. the link period, 0).

Figure 4.2.1 Timeline: price-updating weights



q_i^b *: The quantity of product i in the basket reference period.*

p_i^0 *: The price of product i at the price reference period.*

4.2.8 The next step involves the aggregation of the elementary indices with the new expenditure shares, which have been price-updated to the price reference period[11]. As a result, the CPI formula for measuring the price movements between period 0 and period *t* is:

$$P_{LO}^{t/0} = \sum_i \frac{p_i^t}{p_i^0} \frac{p_i^0 q_i^b}{\sum_i p_i^0 q_i^b}$$

Or its algebraic equivalent:

$$P_{LO}^{t/0} = \sum_i \frac{p_i^t}{p_i^0} \frac{w_i}{\sum_i w_i}$$

4.2.9 Because the price reference period and the weight reference period are different, the index in the above formula is no longer a Laspeyres price index. It is more accurately defined as a Lowe (or fixed-basket) price index. Many statistical agencies will price update the weights of their CPI when introducing a new basket in the index. Such a practice will ensure: (i) the straight-forward interpretation of the index where the result now reflects the change in the cost of purchasing a given set of "quantities" or a given basket of goods and services between two periods; (ii) when this formula is used, the monthly CPI can be produced as a series of monthly chain indices, i.e. whereby the index in, say, period (*t* + 1) can be calculated simply by updating the index from period *t* by applying the relevant price changes (the approach simply calculates the elementary indices as chain-linked monthly indices and then multiplies these with the original weights); and (iii) lastly and probably most importantly, that when the weights are price adjusted, the quantities that were estimated at the weight reference period are repeated (or preserved) at the link period of the new basket. The latter is an important characteristic for the index if the objective of the CPI is to measure the change over time in the cost of a "fixed basket" of goods and services as the one associated with expenditure weights derived from the reference period.

4.2.10 Table 4.2.1 illustrates the technique of price-updating where the index consists of only four elementary indices. It is assumed that the latest available weights refer to 2006, and that they have to be introduced in the CPI from December 2008 with effect as from January 2009. Therefore, to price-update the weights they have to be multiplied by the development from average 2006 to December 2008 in the respective elementary indices. Although simple the example shows the principle of price-updating and rescaling of weights.

4.2.11 The weight of the elementary aggregate C falls from 40% to 36.36% when price-updated because of the relative price fall for C; the price for C is unchanged but since all prices are increasing it is a relative price fall. Because of the lower relative price of C and since it is assumed that the quantities are kept constant, the expenditure share will fall. On the other hand the weight of D increases from 10% to 11.82% as the relative price for D has gone up and since quantities are kept fixed, this means that s larger share of the budget will have to be spent on D.

4.2.12 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

[11] The is also another step which involves recalling the weights shares in order for them to equal unity, once the weights are price updated. This step is covered in chapter 10 that deals with the topic calculation.

Table 4.2.1 Price-updating of expenditure weights

Elementary indices	Weights 2006 (a)	Price index 2006 (b)	Price index Dec 2008 (c)	Price-updated weights Dec 2008 d = a*(c/d)	Price-updated weights re-scaled = d/sum(d)
A	30.00	140.0	156.8	33.60	30.55
B	20.00	120.0	140.4	23.40	21.27
C	40.00	160.0	160.0	40.00	36.36
D	10.00	150.0	195.0	13.00	11.82
Total	100.00			110.00	100.00

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.

4.2.13 The alternative of not price updating the weights, i.e. using the same basket shares as determined by the HBS or National Accounts for the weight-reference period at the point of the chain link month, can be the best approach when it is assumed that quantities purchased react to price changes; note however, that a degree of bias may still be present if consumer behaviour is different than that assumed or expected.

4.2.14 The CPI and its higher-level indices are calculated in this case simply by weighting together the elementary indices from *0* to *t* by their original period *b* expenditure shares This price index formula, which is a Young price index is simply a weighted Carli and is written as:

$$P_{YG}^{t/0} = \sum_i \frac{p_i^t}{p_i^0} \frac{v_i}{\sum_i v_i}$$

Where $v_i = p_i^b q_i^b$ *is the (non-hybrid) value weight for product i*

4.2.15 With the Young formula, the weights are not restricted to any particular period, but may refer to any period or an average of different periods, for example. The underlying premise with the Young index is that weights should be as representative as possible for the average expenditure shares for the period in which the weights are introduced into the CPI. In the Young index, the expenditure shares are kept constant from period b to period 0, with the assumption that the underlying quantities have varied inversely with changes in the relative prices.

4.2.16 If the statistical office considers that the expenditure shares of the weight reference period are the better estimates of the average weights for the period in which the weights are planned to be used in the CPI, this may be an argument for applying the original weights as they stand and omit price-updating. If consumers tend to substitute as a result of changes in relative prices and expenditure shares roughly remain constant, the Young index will provide a good approximation of the price development over period *b* to 0.

4.2.17 When there are pro*n*ounce*d* inverse movements between quantities and prices, price updating the expenditure weights can generate some peculiar results. Take the case of computers, which have recorded strong annual price declines in recent years. If the weights are price-updated this means that a strong decline in computer expenditures can be expected between periods *b* and *0* because of the assumption of fixed quantities applied to the large price declines. In reality, computer expenditures could have risen if the volume of computers sold outpaced their price declines. With rapidly changing relative prices and relative quantities, the only ideal solution is to update the quantities as well as the prices. In other words, new expenditure data have to be collected and introduced into the index on as timely a basis as possible.

4.2.18 The movements of the two indices usually will be different while the magnitude of the difference is likely to increase with the length of the period over which the weights are price-updated. If relative prices stay unchanged from the weight to the price reference period the two set of weights will be similar and the Young and the Lowe index will give similar results.

4.2.19 Both quantities and expenditure shares change through time and progressively more, the

longer the period of time between the weight reference period and the price reference period when the weights are introduced. Thus, whether the weights are price-updated or not, the ideal solution is to review and update them as frequently as possible to reduce the bias that would (or could) otherwise distort the index.

CHAPTER 5

Sampling Procedures

Introduction

5.1 Chapter 5 of the CPI Manual gives advice both on sample selection, that is how to construct a sample (the focus of this chapter), and on estimation procedures, that is how to estimate the CPI from the sample of prices collected (the focus of chapters 7 and 8). The CPI Manual is not prescriptive on the selection of samples, recognising that in practice non-probability sampling often needs to be adopted. Similarly, although paragraph 35 of the 2003 ILO Resolution states that probability sampling techniques are to be preferred, paragraph 36 goes on to say that "where appropriate sampling frames are lacking and it is too costly to obtain them, samples of outlets and products have to be obtained from non-probability methods" and that "statisticians should use available information and apply their best judgement to ensure that representative samples are selected".

Background

5.2 In order to construct a perfectly accurate CPI, the price statistician would need to record the price of every variety of every good and service purchased by the consumer. This would mean collecting a full set of prices from every outlet, including market stalls and street vendors, and from every provider of a service, including public utilities such as water and electricity, private transport including shared minibuses and the hire of rickshaws, modern forms of communication, such as mobile telephones, and the provision of domestic service. As this is not feasible in practice, most prices have to be sampled and this involves local price collection in a selection of outlets in a sample of locations chosen to be representative of the country as a whole and at selected times on selected days.

5.3 The exceptions to the above are prices which can be collected from a central source, such as a public utility provider or a government department. For many of these items, all prices will be taken and no sampling will be involved. For example, the service provider may give the national statistics institute a full price list or tariff from which all the prices can easily be extracted. This may be the case where sampling would not make sense or would be unreliable because the number of prices is very small. For instance, no sampling would be involved if an electricity tariff consisted of a standard standing charge for service provision and a standard charge per kilowatt of electricity used, which was the same for all customers regardless of location and only varied with total usage (with heavy users getting a discount after a certain threshold). In this case the tariff prices would be collected and applied to a typical cross-section of users and varying quantities of electricity. Sampling would be used to choose a cross-section of users.

5.4 This chapter focuses on sampling procedures for local price collection in outlets, including options relating to probability and non-probability sampling. There is a section which specifically addresses the special challenges of sampling prices in markets and prices charged by street traders. The associated issue of price bargaining is addressed in Chapter 6. Chapter 6 also discusses the issue of volatile prices.

5.5 Advice on the sampling of tariffs and other centrally collected prices is given in Chapter 9 on Special Cases. Specific problems arise in a CPI, associated with the drawing of static samples and the maintenance of a fixed basket in a dynamic universe, where retail outlets and goods disappear to be replaced by new ones. Chapter 7 deals with item substitution and quality change and Chapter 8 with how to introduce new items.

5.6 As only a sample of prices will be recorded in the course of local price collection, there is inevitably some sampling error in measuring the CPI. The sampling procedures should aim to minimise this sampling error, maximise sampling efficiency (i.e. obtain the maximum sampling precision for minimum fieldwork and processing costs) and ensure no bias. The sample design itself should allow publication of sub-indices at all levels which have been decided upon, such as regional indices or separate sub-indices for urban and rural areas. As well as cost, a limiting factor in sample design is the time taken in collecting prices. Practical considerations that will need to be taken into account include the availability of price collectors and transportation issues.

5.7 In general, national statistics institutes adopt four levels of sampling for local price collection: locations; outlets within locations; items within different sections of the expenditure classification; and product varieties. Stratification is also frequently used to increase sampling efficiency, especially where the retail market is heterogeneous. Often a mixture of probability sampling and non-probability (purposive) sampling is used.

5.8 When using probability sampling, the units in the sample are selected so that each has a known non-zero probability of selection. For instance, locations could be randomly selected from local administrative areas with probability according to total population[12], the latter representing a proxy for the retail turnover in the area. Within a location, outlets could be randomly selected from a business register, with probability according to their individual turnover of sales or by floor area measured by an enumerator listing and visiting each shop. Sample selection based on probability according to size increases sampling efficiency. Also as the aim is to have a sample which is representative of retail turnover, the prices subsequently collected on the above basis would then not need to be re-balanced by re-weighting if the assumption holds that those population and floor areas are good proxies for turnover. Alternatively, each location and outlet could be given an equal chance of selection in the sample, regardless of the total proportion of the retail market that they account for, but then re-weighting would be necessary.

5.9 In practice, sample selection is never straightforward and compromises have to be made for good practical reasons even when a sampling frame exists. Administrative boundaries can be unusable. For instance, choosing administrative areas using probability according to population will ignore the inconvenience of administrative boundaries that straddle the border between a commercial district and a residential area so that, contrary to the intention, the commercial district has no chance of being selected as it contains no houses. Also a visit to the location may indicate that it is impractical for the collection of prices, for example, because of a physical barrier such as a railway or river bisecting the area and causing difficulties of access. Similarly, very rarely do national statistics institutes have readily available sampling frames which reliably list all retail outlets, particularly recent openings, and even fewer will have lists that cover all market stalls in all types of markets, or mobile street vendors. The relative advantages and disadvantages of random and purposive sampling should be examined at each stage of the sample selection. It is recommended that the National Statistics Institute should first decide on the ideal sampling solution and then modify this to take into account practical constraints.

5.10 The ultimate goal should be:

- An overall sample which is representative of the total population of goods and services being offered for sale and purchased. The sample chosen should be representative of price levels and, most particularly, price movements. All variations of items and outlet types should be considered for each product and chosen to reflect typical consumer purchasing habits.
- A variance or mean square error which is as low as possible. Samples should be reasonably optimised. At the very least, a basic analysis of sampling variance should be conducted, even if an overall estimate of the precision of the CPI cannot be made.
- Optimisation. The entire set of sample prices should be optimized to meet the publication needs of the CPI, taking into account user requirements, practical data collection considerations and cost.

5.11 An overview of some of the main sampling-related issues for a CPI is given first.

5.12 The following paragraphs provide an example of how a sample might be put together, including a discussion of some of the choices to be made. Precisely how the CPI sample is selected in practice will, of course, depend on the individual circumstance of each country. The detailed example does not address the time dimension, which is covered in Chapter 6 on price collection.

Overview

5.13 This section provides an overview of the main sampling issues arising in connection with price collection for a CPI.

5.14 Sampling for a CPI has three dimensions:

- The product dimension, that is, all goods and services available for purchase. Available sampling frames may include:
  - Product lists of major wholesalers and the sales values in a previous period.

[12] A more appropriate alternative might be number of workers employed in the location if this is known. This may be the case where most shopping is done in town centres but with most people living in residential areas in the suburbs.

  - Outlet-specific lists of products (shelf space could be used as a volume of sales measure).
  - Recent Household Budget Surveys.
- The geographical and outlet dimension, that is all places, outlets[13] where a product is sold. Available sampling frames may include:
  - Business registers.
  - Telephone directories.
  - Recent Household Budget Surveys.
- The time dimension, that is, the sub-periods of the index.
  - Less attention is given to this dimension since price variation is usually small over a short time period. Nonetheless it is important. For example, the price of fresh fish or vegetables may vary depending on the time of day, with price reductions towards the end of the day when the product is less fresh, there is unsold stock and buyers are scarce.

5.15 Sampling techniques are used because to include all goods and services would be both cumbersome and costly in term of data collection and processing and could not be carried out in a short enough timescale to allow the timely publication of the CPI.

5.16 But it is also worth bearing in mind that sample data may be of better quality because of, for example:

- The more effective use of a smaller number of more specialised and better trained data collectors, editors and processors.
- More time available to handle the data collected – the time available for data collection, processing and analysis is always short. The more data collected, the less time is available to thoroughly check and edit each price quotation.
- Smaller samples will permit better monitoring of replacements and better quality adjustment control.

5.17 There are two basic methods of sampling: probability sampling and non-probability (purposive) sampling.

5.18 For probability sampling the units (for example, outlet or product) are selected at random with certain non-zero probability. This requires a sampling frame, that is, a list of all the outlets or products eligible to be sampled. There are three main methods of probability sampling:

- Simple random sampling, when outlets or products are sampled with equal probability. This can be used when all the outlets or products are homogeneous. But this is rarely the case in practice. For example, a stall in a rural market is unlikely to sell the same brands and quality of clothing as a store in an urban area selling designer clothes which is also likely to have a much higher volume of sales.
- Systematic sampling, when outlets or products are chosen with equal probability but sampling units are selected at equal "distances" from each other in the frame, with only the first unit being randomly selected. Again the outlets or products should be homogeneous.
- Stratified random sampling with probability proportional to size. This method divides the heterogeneous population of outlets or products into various homogeneous sub-populations or strata. An independent sample of appropriate size is then selected for each stratum.

5.19 The sampling frames required for probability sampling are rarely available, so the price statistician either has to create one or rely on non-probability sampling. For this reason non-probability sampling has been heavily used to draw samples for price collection in the CPI. Unlike probability sampling, non-probability sampling more easily caters for the need to ensure that:

- Samples can be monitored over a long period.
- Price collection takes place in accessible areas where there are price collectors.
- Costs are kept to a minimum.

5.20 Non-probability sampling techniques include:

- Cut-off sampling. This refers to the practice of choosing the "n" largest units from the universe. For example, the decision may be taken to exclude outlets in rural areas with very low turnovers because their small influence on the national CPI does not warrant the collection costs. Clearly careful judgement is needed in determining the cut-off point. Factors to be taken into account include the uses of the CPI. For instance, outlets in rural areas with very low turnovers should not be excluded if a sub-index is to be computed to represent the inflation experience of households living in remote rural areas.

[13] Including retail channels such as the offices of service providers of utilities where they may not be a physical shop which customers can visit.

- Quota sampling. The actual selection of the sample is done using judgemental procedures with respect to known and relevant characteristics, such as the product group, when choosing products to price or the type of outlet (market stall, small shop, retail chain) to select. The sample is drawn in such a way to have the same proportions as the total population or universe to ensure that the sample is representative.
- "Representative item" method. A list of product types is drawn up using tight specifications to provide effective control over the sample. Only products matching the tight specification are priced. Where a product group is relatively heterogeneous, the product list will need to cover a large range of product types to ensure a broad enough sample to be representative. This method is simple, it is easy to maintain central control and quality adjustment can be decided centrally. But if specifications are too tight the price collectors may have difficulty in finding the products and this will lead to fewer price quotes and a deficit in the sample. Loose specifications give the price collector some freedom in choosing locally popular products and varieties and to adjust the sample to match local conditions and are often preferable when pricing fresh products in local markets.

5.21 It should be noted that the size of a country has no bearing on the final precision of a sample estimate. Only the size and allocation of the sample affects the precision of the sample estimate. There is no need for a larger sample merely because a country is large. However, the degree of disaggregation at which the indices will be published will have an effect on the overall sample size. If publication of provincial indices is required then the sample size within each province will need to be sufficiently large to provide reliable estimates at the provincial level. This will mean that the overall national sample will most likely be larger than a sample only intended for a national estimate.

5.22 Many countries have distinctive rural and urban sectors that exhibit very different behaviours. The sample size for both the rural and urban price collections should be sufficiently large to provide reliable and publishable indices for each sector.

5.23 Sample size and the precision of the estimate of price change will depend on the homogeneity of the retail market. The more heterogeneous the retail market the bigger the sample required for a given level of precision.

Illustrative example of selecting a sample for price collection

Sampling of locations

5.24 For large countries location sampling normally takes place separately within each region of the country to ensure that the selection of the locations is representative of the whole of the country. The practical steps associated with location sampling are essentially the same regardless of whether or not a sampling frame for the outlet dimension can be designed.

5.25 Location selection can take place, separately within each region for a large country, using Probability Proportional to Size (PPS) sampling with a size measure relating to retail turnover or an appropriate proxy such as number of employees in the retail sector. The number of locations in each region may be determined as the proportion of national expenditure (or a corresponding proxy measure such as regional GDP) in that region, multiplied by the total number of locations to be visited nationally.

5.26 PPS sampling within a region proceeds as follows. The first stage is to order the sample base locations randomly and calculate the cumulative total of retail turnover, producing a range for the retail turnover associated with each location. Selection of locations then takes place using interval sampling with the interval value calculated by dividing the cumulative total of turnover by the number of locations to be sampled. Checks should be made to ensure that the properties of a PPS sample hold, for instance, that in the cases where a location has a turnover larger than the interval value, the location is selected with certainty.

5.27 Systematic sampling (sometimes referred to as interval sampling) can then be performed. This is done by generating a random starting point between zero and the interval value. The location, within whose range of turnover the starting value lies, is selected as the first location. The second random number is generated by adding the interval value to the starting point. This is then used to select the second location by choosing the location whose range of turnover contains the new random number. This process of adding the interval value to the previous random number, and selecting the corresponding location, is repeated until the requisite number of locations has been sampled.

5.28 This is illustrated in Figure 5.1. The number of outlets given in the second column will only be

Figure 5.1 Location selection

Location Name	No. Outlets	No. Employees	Cumulative Total	Range Lower	Range Upper	
Location A	607	5377	5377	1	5377	
Location B	306	2486	7863	5378	7863	
Location C	264	2265	10128	7864	10128	Section 1
Location D	449	4006	14134	10129	14134	
Location E	322	2589	16723	14135	16723	
Location F	319	2097	18820	16724	18820	
Location G	283	2127	20947	18821	20947	
Location H	457	5252	26199	20948	26199	
Location I	539	4945	31144	26200	31144	Section 2
Location J	371	4101	35246	31145	35246	
Location K	518	4875	40121	35247	40121	
Location L	928	10923	51044	40122	51044	
Location M	407	3366	54410	51045	54410	Section 3
Location N	374	2449	56859	54411	56859	
Location O	539	3625	60484	56860	60484	
Location P	326	3357	63841	60485	63841	
Location Q	291	4273	66314	63842	66314	
Location R	277	2052	68366	66315	68366	
Location S	1815	16499	84865	68367	84865	Section 4
Location T	443	3930	88795	84866	88795	
Location U	329	2387	91182	88796	91182	
Location V	258	2122	93304	91183	93304	
Location W	420	3513	96817	93305	96817	Section 5
Location X	1714	20335	117152	96818	117152	
Location Y	305	2819	119971	117153	119971	Section 6
Location Z	458	3429	123400	119972	123400	
Location AA	380	3777	127177	123401	127177	
Location BB	264	2375	129552	127178	129552	
Location CC	452	6218	135770	129553	135770	
Location DD	271	1839	137609	135771	137609	
Location EE	250	1792	139401	137610	139401	Section 7
Location FF	870	8100	147501	139402	147501	
Location GG	1315	16303	163804	147502	163804	Section 8
Location HH	321	2139	165943	163805	165943	
Location II	283	2227	168170	165944	168170	
Location JJ†	2365	21887	190057	168171	190057	Section 9
Location KK	312	3097	193154	190058	193154	
Location LL	314	2724	195878	193155	195878	
Location MM	332	2649	198527	195879	198527	
Location NN	309	1723	200250	198528	200250	
Location OO	892	7864	208114	200251	208114	Section 10
Location PP	499	5921	214035	208115	214035	
Location QQ	408	3299	217334	214036	217334	

No. of collections of basket*	10	**For example, ten price collectors collecting prices in ten locations*
Employment total	217334	
Interval value	21733.4	= Employment total/No. of collections of basket
Random number	0.39904	
Random starting point	8672.5	= Interval value x Random Number

Random numbers for selection:	
8672.5	= Random Starting Point
30405.9	= Random Starting Point + Interval Value
52139.3	= Random Starting Point + 2 x Interval Value
73872.7	= Random Starting Point + 3 x Interval Value
95606.1	= Random Starting Point + 4 x Interval Value
117339.5	= Random Starting Point + 5 x Interval Value
139072.9	= Random Starting Point + 6 x Interval Value
160806.3	= Random Starting Point + 7 x Interval Value
182539.7	= Random Starting Point + 8 x Interval Value
204273.1	= Random Starting Point + 9 x Interval Value

†JJ will be selected with certainty.

available if a suitable sampling frame or higher level statistical analysis of outlets is available.

5.29 The process described above may need to be modified to take into account practical considerations but this should be done, without compromising the principle of random sampling, through operational procedures which provide sufficiently detailed guidelines that minimise the scope for ad-hoc decision making and subjectivity. For example, collection costs are an important consideration and it may not be efficient to send a price collector to a small isolated location where many of the items in the CPI basket are not available for pricing. In these circumstances, the price

statistician may decide that in order to ensure that a full shopping basket (all the items in the CPI) can be collected in each selected location, then locations with less than a certain number of outlets should be excluded. Similarly, a decision might be taken to pair an out-of-town shopping area with a small adjacent location in the near vicinity to form a new location. This may be done where the out-of-town shopping area does not contain food outlets, despite attracting significant expenditure on non-food items, such as electrical goods, home furnishing and decorating and other home improvement goods. In order to obtain a full basket it may be necessary to pair such out-of-town shopping areas with locations in which food is available.

Sampling of outlets

Judgmental sampling

5.30 For this method, price collectors are instructed to choose outlets which are reasonably popular with the typical shopper and which will represent the typical shopping pattern in the area for the types of products being priced. This can be done by providing a check list which provides further detail of the characteristics to look for. It is unlikely all these characteristics will be available from a central register. This method of sampling often involves the price collector visiting the outlet to gather together the necessary information on the outlet's characteristics prior to decisions being made on its inclusion in the sample. For instance, if prices for children's clothes are to be collected, a price collector may visit a clothes shop initially selected from a central list to check whether it sells children's clothes and not just adult's clothes.

PPS sampling

5.31 Sampling frames for the outlet dimension can be derived from several sources including:

- Business registers. These are lists of businesses, normally maintained by the National Statistics Institute or Ministry of Commerce. They may contain information such as location, type of business activity, turnover, and employment. Business registers should be updated regularly both for new businesses and just as importantly for closures. Provided that some size measure is included in the information, business registers can provide a useful basis for preparing a PPS sample.
- Telephone directories of businesses (e.g. "yellow pages"). These normally contain less information, for instance just business name, address and business activity. They do not include any size information. Therefore they are useful for simple random sampling or systematic sampling but not for PPS sampling unless additional information is sought, for example by visiting the outlets.
- Records of local administrations. These might be records kept by local government, associations of businesses or market place managers etc. These records could be used to create frames and might be particularly useful for sampling local markets. Depending on the presence of information on size, these sources might be able to provide a frame for PPS sampling.
- Recent Household Income and Expenditure Surveys (HIES) or Household Budget Surveys (HBS). Some of these surveys are designed to indicate, on the survey form, the actual outlets from where the households purchased the goods and services recorded ("point-of-purchase" surveys). Surveys that do include this information could be used as a source of relevant outlets for survey frames for various regions. In addition, the number of survey respondents making purchases could be used as a measure of retail turnover for PPS sampling. But a survey is normally a sample and so is unlikely to constitute a complete list of all the outlets available to consumers.

5.32 In the absence of existing sources as suggested above, it is necessary for the outlets in a location to be enumerated to provide supplementary information for the sampling frame or to construct a sampling frame from scratch. This enumeration could be carried out by price collectors or their supervisors, visiting each location and noting details of all retail outlets found. It can be a very costly activity and the price statistician will need to weigh up the costs against the benefits in terms of a more representative sample. To reduce costs the price statistician may decide to limit the number of outlets enumerated per location, for instance by enumerating only a sub-district of a location. The details noted for each outlet during enumeration might include: address; the range of items sold; and whether it is independent or a branch of a multiple. Shops of centrally collected chains of retail outlets, markets stalls and street vendors would normally be excluded from the enumeration as they will be subject to different sampling procedures or at the very least be part of a separate exercise. Prices in a CPI are combined using expenditure weights. In order to use PPS sampling the ideal size measure of an outlet would be turnover. But a proxy may be used where an estimate of this is not readily available. For instance, the approximate net retail floor space, as estimated by the outlet enumerators,

may provide an adequate alternative. For shops, such as department stores, selling a wide variety of goods, the floor space devoted to each commodity group should be measured.

5.33 The reason for recording the range of items sold in a shop is to provide a link between outlets and items to enable some form of sample stratification, so that outlets selected for inclusion in the sample provide an adequate range of goods to generate sufficient prices for the CPI basket. Where COICOP isn't used to code what categories of goods each shop sells, an appropriate mapping should be created to map across to the corresponding COICOP category to allow outlets to be classified by commodity group. Whilst this may not be a true stratification - an outlet may be in more than one stratum if it sells items from more than one commodity group – it should be adequate for the purpose of drawing a sample of outlets for the CPI.

5.34 For each commodity group, the required number of outlets, plus some reserves (used if an outlet closes down) is then drawn from the sampling frame by either simple random sampling (SRS) or PPS sampling. The latter is used where there is known to be a wide range of store sizes and therefore a wide range of turnover, such as for furniture or hardware stores which may be superstores or local shops.

5.35 The framework in Table 5.1 shows how this approach works for meat. Items are grouped into commodity groups, so fresh beef and lamb are grouped together, as are all cooked meats. The second column lists the types of outlet where meat is sold. These meat items are sold in butchers, supermarkets, and, although less frequently, some department stores. The third column shows whether a multiple or an independent shop should be selected: for meat, or whether either may be selected. The fourth column shows how many prices should be collected in each location for that commodity group (two for meat). For meat, there should be one price from a butcher and one from either a supermarket or a department store that sells meat. The fifth column shows what type of sampling is used to select the sampled outlets from all those of that type in that location. The butcher is selected by a simple random sample of all butchers in that location; the supermarket or department store is sampled with probability proportional to size, since store size in this outlet group is likely to vary widely.

5.36 A shop holding a closing down sale should be treated as already closed and hence should be excluded from the sampling frame. This is because its prices will not be comparable with previous ones, and will not be available in the future.

5.37 Examining Table 5.1 in more detail, the decision making process works as follows:

- In the context of outlet selection, the *commodity group column* relates to the way in which similar types of items are grouped according to the type of shop in which they are likely to be found. Collectors are required to collect prices for all items within a particular commodity group - so in this particular example all three meat commodity groups need to be collected from butchers. Although it has no direct bearing on sampling other than to provide a framework to identify the different types of shops in which we might want to collect prices, it can be seen that this categorisation approach is useful from a field management perspective.
- *Outlet types* relates to a form of stratification intended to ensure that prices are collected from all types of outlet. In the case of cooked meats, or any other meat product listed, this

Table 5.1 Outlet selection procedures

COMMODITY GROUP (in this case meat)	Outlet types TO SELECT	TYPE	NO	SAMPLE
	Butcher	M or I	1	SRS
1 Fresh beef & lamb	Supermarket	M or I	1	PPS
2 Cooked meats	Supermarket			
3 Fresh bacon, pork, chicken	Department store			

Key: M = multiple store; I = independent store; SRS = simple random sample; PPS = probability proportional to size.

might in theory cover small one-man shops, small supermarkets, large or out of town supermarkets. The decision on the number of types of outlet from which to collect prices for each meat product will depend on a number of factors including the extent to which price movements for a particular commodity group vary by outlet type; the overall weight of the items collected in those shops; the aggregation formula (greater stratification increases homogeneity, which is particularly advantageous if the ratio of averages is used in the elementary aggregate); and whether average prices are required either for publication or for imputing the data into the computation of purchasing power parities (PPPs) (see Chapter 17). In the case of the latter a representative full cross-section of shops is required and, probably, a larger sample.

- *Sample methodology column*. The sampling methodology will depend in large part on the homogeneity of shop sizes, the assumption being that larger shops have more sales. Butchers (or, for example, small independent grocers) tend to be of similar size so SRS which is easy to apply is used. For larger stores, this may not be the case and PPS should be used using a proxy measure for turnover. Estimating floor area of that part of a store devoted to a particular type of product (e.g. meat items) and using this as a proxy for turnover, just one of a number of possible approaches, can be difficult. For example, the stock may be on the counter in a butchery department, in fridges or in freezers which are generally not co-located. So overall floor area of the store may be used as a proxy and PPS is applied using this proxy. Of course, the assumption that the floor area of a store is directly proportional to sales of a particular product may be questioned. For example, larger stores are likely to stock a wider range of products (e.g. some large supermarkets stock electrical goods and clothing); but it may be as good an assumption as any depending on local circumstances.

Sampling of representative items

5.38 The sampling of representative items for a CPI is usually purposive or judgmental. The significant difficulties involved in defining an adequate sampling frame (that is, a list of all the individual goods and services bought by households), often preclude the use of standard random sampling methods.

5.39 A number of factors need to be taken into account when choosing representative items. Specific brands or varieties conforming to the item description must be easy to find by the price collectors, ensuring that estimates of price changes are based on an adequate number of price quotations. As far as possible, they should also be available for purchase during the life of the CPI basket. For instance, if the CPI is based on the cost of a fixed annual basket of goods and services, the expectation should be that the specific brands or varieties selected will be available throughout the year. The exception is certain products, such as some foods, which are seasonal, and so require a slightly different treatment (see Chapter 9).

5.40 In selecting the sample of items to represent distinct categories of household spending, the items must be well defined so that changes in the recorded prices from month to month reflect only the change in price and not changes in the products observed. However, sometimes a relatively wide definition is used to accommodate rapidly changing consumer tastes, for instance clothing where fashions can change very rapidly, particularly designer clothes and such things as football T-shirts with club logos and players' names. If the definitions were too specific in these cases it would be very difficult for the price collectors to find the examples of the items in the shops. The diversity of products and therefore the range of possible price quotations that conform to a particular item description have implications for the choice of elementary aggregation method (see Chapter 10). Examples of typical item descriptions are given below:

- large loaf, white, unsliced (800g);
- locally killed fresh beef stored in refrigerated conditions, rump steak (per kg);
- butter, home produced (250g);
- heap of fresh vegetables: greens (per kg);
- bundle of firewood (per kilo);
- local beer (half a litre);
- single bed (width approx. 3ft/90cm);
- electric cooker, 4 rings, grill and oven;
- domestic help (hourly rate);and
- men's cotton suit (ready made).

5.41 The number of items chosen to represent price changes within each CPI commodity category will depend on the weight of the section and the variability of price changes between the various items that could be chosen to represent the category (reflecting, for example, the diversity of products available). Intuitively, it makes sense to select more

items in product groups for which total expenditure is high; this helps to minimise volatility in estimates of price changes for high-weighted categories and therefore in the CPI overall. However, if price movements for all possible items in a given category are very similar, it is sufficient to collect prices for only a few. By contrast, if price movements within a category are very different, a much larger selection of representative items will be needed to get a reliable estimate of price change for the category as a whole. For instance, a relatively large number of items may be selected in areas such as food and clothing, whereas price changes for more homogeneous product categories such as petrol, alcohol and tobacco may be based on fewer items.

5.42 In practice, relative expenditures on the different types of goods and services will play an important role in determining the selection of representative items used to compile a CPI, using Household Budget Survey data on household spending patterns, the same source of information which underpins the calculation of weights (see chapter 4). This may be supplemented by information on retailing trends from trade journals and press reports. A request can also be made to the price collectors and supervisors to report developments in the retail environment.

5.43 The usual practice is for representative items to be selected by Headquarters to ensure that they are representative of consumer behaviour as a whole rather than one particular shopping location. Consistent with the principle of a fixed basket they are normally reviewed periodically at the same time as the weights and chain-linking is carried out (see Chapter 10).

Selection of products and varieties

5.44 For most, if not all, products, the selection of products and varieties within outlets will be purposive. In each outlet collectors choose one variety representative of what people buy in the area or which people typically purchase in the outlet from all products matching the specification of each item to be priced in that outlet. To facilitate this they may ask the retailer what are the most popular brands and which are those stocked regularly. As it is vital that the same product is priced each month, collectors must record enough detail of the product, such as make and model, to ensure that it is uniquely identified.

5.45 The chosen products should be reviewed periodically to ensure that what is being priced still reflects the above criteria. If the product being priced becomes permanently unavailable, one that is available must be chosen as the replacement so that there is a valid base price. When this is part of a general and systematic updating of the CPI basket, prices should be collected for both the old and new products simultaneously in one month, where possible, to permit chain-linking. As mentioned earlier, chapters 6 and 7 provide more practical guidance on price collection, substitution and quality change.

Replacement of disappearing outlets and products

5.46 Sometimes price collectors will find that an outlet at which they have been collecting prices closes or no longer stocks one of the products being priced. Disappearing outlets and products within a specific outlet are handled by re-sampling on a one-to-one basis when the outlet closes or the product ceases to be sold by the selected outlet. The criteria for selecting replacements will vary:

- Replacing an outlet on a like-for-like basis by another market stall, independent shop or retail chain in the same or similar location selling the same or similar range of items and products.
- In replacing a product one of two strategies is usually adopted. If the initial selection rule was "most sold" or "probability proportional to (sales) size" then the replacement could follow the same rule with the advantage of maintaining the representativity of the sample. Alternatively, the replacement may be made based on the product most similar to the one which disappeared, thereby reducing the need for quality adjustment.

5.47 A more proactive approach is recommended where there is a high turnover in outlets and products so that the number of forced replacements, referred to above, is kept to a minimum. This can be done by sample rotation, which for products is usually associated with the overlap method of adjusting for quality change (see Chapter 7) and with chain linking (see Chapter 10). Sample rotation involves full or partial re-sampling. The method of re-sampling can follow any of the methods used for initial sample selection. Re-sampling involves an overlap period where the first period of the new sample overlaps with the last period of the old sample. Sample rotation can also be applied to items.

Sampling procedures for markets and for prices charged by street traders

5.48 In many countries there are distinct outlet types for the selling of goods and services: shops, traditional markets and mobile vendors. Each outlet

type tends to be a distinct part of retailing, often with very little customer overlap. Each is likely to follow a different pricing behaviour and so prices must be obtained from each.

5.49 Markets, particularly unlicensed or unregulated ones, and street traders are particularly challenging for the compiler of a CPI both from a sampling perspective and from the point of view of obtaining the appropriate "representative" price (the bargaining issue, which is addressed in Chapter 6). As far as sample selection is concerned, the CPI statistician is often confronted with the challenge of:

- Constructing a tailor-made sampling frame. For instance, there might be information available from city or other local administrations if stallholders have to register in order to operate. Alternatively, the price collectors themselves may have to construct a list of traders in a locality. This would be feasible if most of them occupy the same space every day.
- Using a mixture of quota sampling and the selection of "representative items or products" to get a sample of individual prices. For instance, judgemental procedures with respect to known and relevant characteristics, such as the product group, could be used when choosing which items or products to price in a particular type of outlet (for example, the choice of fresh vegetables to price in a market). Then for the actual price collection the "representative product" method could be adopted. A list of tightly specified product types is drawn up to provide effective control of the item sample and price collectors are asked to collect "representative" prices for these products by visiting a "typical" market stall or street vendor. Prices are collected only for the products matching this tight item specification

5.50 Mobile vendors are particularly difficult to include in a sample frame as they move around and may not trade every day or even regularly. Mobile vendors may be a significant part of retail activity and so should not be ignored just because they are informal. One option, adopted by many countries, is to treat the locations where mobile vendors regularly sell their wares as "pseudo-outlets".

5.51 For instance, if it is known that second-hand clothes can always be purchased at a particular street corner (but the individual vendors change), then consideration can be given to treating the corner as the outlet. This collection method assumes that buyers have no preference between the vendors and consider them as providing goods of similar quality.

5.52 Price collectors should be instructed to visit different market stalls or street vendors until a representative price is obtained. The latter will be a price which the price collector, from their experience of price collection, considers reasonable for the specified item of pre-determined quality. It is advisable to use tight item specifications for markets and street traders.

CHAPTER 6

Price Collection

Introduction

6.1 Chapter 6 of the CPI Manual provides an overview of the most appropriate survey methods for the collection of prices. In large part, the considerations are the same as for sample design and will depend on local circumstance. For instance: the purchasing habits of consumers and the extent to which they use licensed and unlicensed markets (regulated and unregulated or informal markets) and use catalogues for postal shopping; the structure of the retail market including the balance between markets, small independent shops and large retail chains; the extent of public ownership and price control; the diversity of goods and services being sold; the pricing structures used, including tariffs; and whether bargaining is common. The availability of central records of prices charged also has an important bearing. Paragraph 48 of the 2003 ILO Resolution emphasises the importance of well-trained price collectors who adhere to the standard procedures. The latter are elaborated in subsequent paragraphs which cover the rules relating to transaction prices.

Background

6.2 There are two basic price collection methods:

- *Local price collection* where prices are obtained from outlets located around the country. This will include licensed and unlicensed markets and street vendors as well as shops. Normally the price collector will need to visit the outlet although the prices for some items may be collected by other means, including telephone and price lists.
- *Central price collection*. This is often used where prices can be collected by Headquarters without the need for field work. This may also include centrally regulated or centrally fixed prices which can be obtained from the regulatory authorities, although in these cases checks will need to be made to ensure that the goods and services in question are actually available and actually sold at the stated price. It is not unusual to find goods subject to price control being sold at a different "unofficial" price. Central price collection can be further broken down into:
    - Prices which are combined with prices collected locally. For instance this may occur when a supermarket chain provides a centrally determined price list, eliminating the need for the price collector to visit a shop in person;
    - Prices which are used on their own to compute centrally constructed indices. Most tariffs fall into this category.

6.3 Goods and services, such as public transport fares, electricity, mains water supply, physicians, hospital services and telecommunications, which are paid according to a tariff normally, for the utilities, consisting of a standard rate per unit of consumption, sometimes in combination with a fixed charge, can pose problems when their structures are modified over time, damaging the principle of unchanged consumption. A solution to this problem is to define representative services or bundles of services (for example, categories of consumers and specific services consumed). For these it is important that the prices experienced by a representative range of customers and tariffs are observed and that customer profiles are kept constant over time. More detailed advice is given in Chapter 9 on Special Cases.

6.4 The focus of this chapter is on locally collected prices. It begins by reviewing the principles behind collecting prices for a CPI and then considers the practical collection issues and how these should be managed. A working assumption has been made that the index being compiled is an acquisition index (see Chapter 4).

6.5 For the purpose of this chapter, it is also assumed that prices are being collected for a monthly price index with prices therefore being collected, in general, every month. Some countries produce only a quarterly CPI, while others produce a weekly index, especially for fresh food. The concepts and procedures discussed here will apply to price collection practices, whatever the frequency of index publication.

The principles of price collection

6.6 Except in a small number of cases, such as the treatment of owner-occupier housing costs (see Chapter 9), a CPI normally is designed to measure the change in the actual transaction prices of products and services bought by consumers. However, collectors cannot normally observe individual transactions as they occur, so they must usually observe the price marked on or nearby the product and assume that these are the transaction prices. There are exceptions to this, such as bargaining, where a price might not even be displayed and these cases are discussed in the section entitled "Practical collection procedures". Special procedures apply when outlets in which items are being priced close down, or the items which the price collector was pricing at a particular outlet are no longer sold by that outlet. These procedures are covered in Chapter 5 with additional references in chapters 7 and 10.

Catalogue and list prices (not mail order)[14]

6.7 It can be argued that the use of catalogue or list prices, which supposedly give the prices at which goods and services are sold in outlets, is contrary to the principle of recording transaction prices, as the catalogue or list price may only be the recommended price. Even where it is supposed to be the actual price charged shopkeepers may not always comply. However, in many cases the list price is identical to the transaction price. In practice list prices can be a cost-effective method of obtaining prices. They can be used - but their reliability should be checked periodically.

Collection by telephone

6.8 The prices for certain items, particularly services such as electricians' and plumbers' charges and the cost of home security, may be obtained by telephoning the business or organisation concerned. This is the case where it is relatively easy to avoid ambiguities in price as the outlets provide standard items or services. However, even if prices are obtained by telephone, the retailer should be visited occasionally. This helps to maintain cooperation through personal contact and to ensure that there are no misunderstandings over the prices. This will be more important for some retailers than others. For example, the price of hiring a van may be less certain than the cost of an eye test.

[14] The pricing of goods and services ordered by mail can be conducted by reference to mail order catalogues and the index will need to take into account posting and packing costs.

The principle of a fixed basket

6.9 Underlying all of what follows is an important principle: the necessity to compare prices on a like-to-like basis from one period to the next. This has two consequences:

- Where the price collector has some discrimination in what variety of a product to price in a particular shop, a consideration should be whether that variety will be available to price over a reasonably long period (tight specifications are of no use if the described item cannot be found in the outlets). This is in addition to being typical of what is sold to customers.
- The price collector should record additional information needed to ensure the unique identification of the variety priced so that:
    - The same variety continues to be priced in the case of price collection being carried out by a different person.
    - The identification of quality change can be made when the variety disappears and is replaced by a different one allowing an adjustment for quality change to be made.

Item specifications

6.10 There are no firm rules, especially regarding the use of loose or tight item specifications: each country may choose its preferred methods – and stick to them. However, there are a number of considerations in deciding on item specifications:

- Tight specifications leave less discretion to the price collector, so the reliability and training of collectors are factors to consider when deciding whether to use loose or tight specifications.
- Particular care should be taken to ensure that the specification is very detailed for heterogeneous items where there is scope for significant difference between one variety and another, and for items which by their very nature are highly-specified. Cars and hi-tech goods fall into the latter category.
- Tight specifications also allow for the calculation of meaningful average prices:
    - Average prices are useful in identifying outliers and assessing the accuracy of the reported prices.

- Average prices allow comparisons of price levels, including between, say, regions or urban and rural communities.

6.11 Responsibility for specifying the items to be priced should normally rest with Headquarters. Specifications should be reviewed on a regular basis in order to determine whether they continue to be relevant. A revision of specifications could be implied by:

- A large number of missing price quotations.
- A large number of substitutions.
- A wide variation in the distribution of collected price levels.

6.12 Some countries find structured product descriptions (SPDs) from the International Comparison Programme (ICP) helpful for specifying items to be priced in a CPI. As well as providing a ready-made framework for detailed item specifications the use of SPDs has the additional advantage of facilitating greater integration between the two price collection exercises leading, amongst other things, to savings in collection costs from using the same price quotes in both the CPI and ICP. SPDs are sometimes used in conjunction with a "photo bank" which gives the price collector a photograph of the item to be priced. An example of an SPD with "photo bank" is given in Table 6.1. A more detailed description of the structure of an SPD, and how it is used in price collection, is given in Appendix 6.1. The structure of an SPD is hierarchical. In this particular example the 'CPI heading' code on the SPD "photo bank" form consists of the following:

Table 6.1 Structured Product Descriptions: example of a photo bank

Product code	Product group	Indicator product	Picture	Comments
1. FOOD **1.1.Dry Food**				
01111001	Rice	**Rice** *Brand name*: Tastic *Quantity*: 1 bag *Size*: 2 *Unit of size*: kilogram		-
01112001	Bread	**Loaf of white bread** *Note*: If no Brand name is indicated, use the Outlet name as the Brand name, e.g. Woolworts. *Product name*: White sliced bread *Quantity*: 1 loaf *Size*: 700 *Unit of size*: gram		-
01112002	Bread	**Loaf of brown bread** *Brand name*: Albany Bakeries *Product name*: Superior brown bread *Quantity*: 1 loaf *Size*: 700 *Unit of size*: gram		-
01112003	Biscuits	**Sweet biscuits** *Brand name*: Bakers *Product name*: Blue Label Marie *Quantity*: 1 pack *Size*: 200 *Unit of size*: gram *Brand name*: Bakers *Product name*: Eet-Sum-Mor *Quantity*: 1 box	 	Marie biscuits

- CPI group code.
- Item Group Description.
- Item Subgroup Description.
- ICP Heading Code.
- ICP Cluster Code

6.13 SPDs assist greatly in preventing price collectors from inadvertently switching items after the original selection of items have been made. Detail product specifications also aid in identifying where specification changes have occurred which may have to be addressed in quality adjustments. Data on captured product specifications can be used for comparisons across areas and improved standardisation and quality. Thereby also providing information on where training interventions are required.

The prices to be collected

6.14 With a few exceptions, in particular owner-occupier housing costs, for a standard CPI it is the transaction prices which should be collected:

- For goods this is normally the marked price in the shop or on the market stall.
- For some services this may be represented by a tariff or a daily or hourly rate. Tariffs are considered in more detail in Chapter 9.

6.15 But the price collector should check that the marked price is the actual price paid, for instance by asking the shopkeeper or service provider at the start of price collection whether this is case or whether there are some exceptions. Similar enquiries should be made in the case of catalogues.

Quantities

6.16 Many products, mainly food items, are sold on the basis of a locally defined quantity, such as 'bunch', 'bundle', 'heap' or 'pile'. To obtain a price relating to a standard quantity as required for a fixed basket, the exact weight of the product needs to be obtained. This will require the price collector to purchase the product unless the seller is willing to let the product be weighed at the shop or market stall. The standard price, such as $ per kilo can be calculated.

Discounts and special offers

6.17 There are many ways in which retailers tempt shoppers with special offers, and new ways are constantly being devised. Listed below are the various types of situation which price collectors are likely to meet. These help illustrate the general principles to be followed in other cases. Price collectors should make extensive notes on the situations confronted so that decisions on how to treat price reductions can be quality-assured and reviewed at Headquarters.

Regular sales

6.18 These are annual or more frequent events when shops reduce prices on much of their stock (for example, winter sales or summer sales). The total value of purchases at sales prices can often exceed the value at regular prices, and the CPI should include them. Collectors should record on their forms the fact that the price is discounted so that they are not assumed to be a mistake when being compared with the previous price, and also to validate future price collections when the price returns to the normal one.

6.19 Retailers sometimes bring in special stock at a lower price, especially for the sales, but the quality of the products may not be the same as those previously sold. Or the sale may include old stock which has deteriorated in quality (e.g. shop-soiled), or, for food items, stale or close to the "sell-by" date. In such cases, the price (often called a 'clearance' price) should not normally be collected. On some occasions, it may be thought desirable to include the product but with an appropriate quality adjustment (see Chapter 7). But in most cases it would not be possible to make a reasonable estimate of the value of the quality difference between the sale product and the product which it has replaced.

Special offers

6.20 Apart from regular sales, many shops offer temporary discounts on particular products. These may be treated in the same way as regular sales prices, but collectors should be careful to ensure that the products are comparable with those which they have been monitoring at the regular price. They may also be the subject of special purchases or be old stock (see above), and should then be either excluded from the survey or included with a quality adjustment (again see Chapter 7). Introductory special offers should in principle be covered where they arise, but by definition they are unlikely to be included in the current basket and introducing a new product into the basket at a special offer price can cause upward bias in the index as the return to the normal price will cause an upward jump in the price (a return from sale price) which is not matched by an initial drop in price (a move to sale price).

Bonus offers, extras and free gifts

6.21 An item may sometimes be sold with "x% extra free". In general the price should be adjusted

to reflect the greater quantity if the extra quantity is believed to be of value to most consumers. For instance, an extra free 50 grams of coffee when purchasing coffee would generally be considered as having value for a majority of consumers so the price should be adjusted downwards pro rata.

6.22 But there are important exceptions. The CPI Manual states that the price should not be adjusted "if it is thought that the extra quantities involved may not be wanted by most consumers, will not have influenced the decision to buy or will not be consumed" (paragraph 6.84). Another possible exception is "buy 2 get 1 free" or "free gift with every purchase". It is argued by many price statisticians that an adjustment to the price is not appropriate for two main reasons: the item on offer no longer represents the product defined in the CPI basket (e.g. the CPI item is "one shirt", and "two shirts" is considered a different item) and, at least in some circumstances, the offer may be of little or no value to most consumers. But note that "temporary" offers can sometimes become permanent and this may require a change in the item or product specification. Price collectors should be on the lookout for such situations. Guidance on the treatment of informal bonuses offered during bargaining, in the form of additional quantities, is given later in the chapter.

Discounts restricted to particular groups

6.23 In accordance with the underlying principles of a CPI, these should normally be ignored as they do not apply to consumers in general, but only to particular groups such as trade union members or the "first 100 customers". An exception may be made when the discriminatory prices are significant in coverage and available to an identifiable subgroup of the population which is not a result of action taken by the individual, for example joining a trade union. Provided that the subgroup qualifies for the discount due to a characteristic such as age, and individuals have to take no special action prior to purchase or when purchasing, then the discounted price should be recorded. In these cases it is advisable to stratify the product sample so that the discounted item is treated as a separate item from the full price item (see CPI Manual paragraph 6.82).

6.24 In some countries, certain products (especially services such as entrances to museums etc) are officially sold to foreigners at higher prices than to nationals. This is often referred to as "dual pricing". The inclusion of such sales depends on the scope and coverage of the CPI, in particular whether the geographical coverage of the consumption expenditure is the consumption within the country including foreign visitors (the domestic concept) or is restricted to the resident population (the national concept) (see Chapter 2 on the Scope of the CPI). The instructions to price collectors should make it clear which price is being monitored. If both price levels are being monitored in the CPI, it is recommended that two separate specifications are kept. (See CPI Manual paragraph 6.82).

Regular rebates or refunds

6.25 Returnable deposits on bottles or other containers should be deducted from the price, but a "cash back" offer on a large durable after a long period should be ignored. The difference in treatment is justified by the fact that in the first example it is likely to affect shoppers' decisions, whilst in the second example it is not. Clearly there is an element of judgement involved in deciding which rebates or refunds should be taken into account. In ambiguous situations, a country should decide on a rule and, most importantly to ensure consistency over time, stick to it.

Irregular rebates or refunds

6.26 Loyalty rebates or coupons should be ignored, as they place conditions on eligibility or require additional action by the consumer. These rebates disobey the general rule that discounted prices should be included in a CPI only if they are available to anyone with no conditions attached.

Stamps

6.27 Stamps, redeemable against future purchases, are sometimes given to shoppers. These should be ignored, unless a discount is available as an alternative to all customers.

Finance incentives

6.28 Incentives such as a zero-interest loan for buying a new car should either be ignored entirely or, where included in the index, treated consistently with the rules for changes in specification, i.e. any change in the terms of the financial incentive should be reflected in the index. These alternative policies have the effect of removing the hidden credit element from the price entirely, or removing changes in the credit element.

Trade-in prices

6.29 These apply especially to car purchases, where the price of the new car or second-hand replacement car is reduced in return for trading in the old car which is being replaced. Where the dealer re-sells the second-hand goods, usually after carrying out renovation, cleaning or maintenance this is categorised in the national accounts as a purchase by another household via a dealer.

Theoretically these purchases should be included with a "net" weight reflecting the difference between the buying and the selling price which is deemed to represent the "service" the dealer is giving the buyer. This means that the trade-in price received by the seller should not be treated as a price reduction - even though in some cases the price of the new car may be genuinely "discounted" as a result of personal bargaining where the price given for the old car is higher than would otherwise have been the case. In line with national accounts conventions the CPI will pick this up as a second-hand transaction when the old car is purchased from the dealer by another household. In short, it is usually best to simply record the selling price of new cars without a trade-in. Chapter 9 provides more guidance on the pricing of second-hand goods.

Sales taxes

6.30 Sometimes, taxes are not included in the advertised prices but are added on at the cash desk. As the CPI requires that all taxes be included in the collected price, collectors must record on the collection form that the observed price is tax-exclusive and the rate of tax which applies, where the latter can vary by product or administrative region. The tax should be added later, preferably in the computing system.

Foreign currency denominated prices

6.31 It has been the practice of some Central Bank to allow selected retailers to sell goods in a foreign currency while other shops sell goods in the local currency.

6.32 Where this is common enough practice to mean that its exclusion from the CPI basket would undermine how representative the latter is of the prices paid by the average consumer, the price collector should collect prices of items quoted in foreign currency from outlets selling goods in foreign currency. The price should then be converted into local currency using an average foreign currency rate obtained by the price collector on that particular day of price collection from appropriate dealers in the foreign exchange market.

6.33 The price in local currency (obtained after conversion) is the one which should be used in the CPI. The price collector should provide head office with the foreign currency price and the foreign currency rate of exchange for quality assurance purposes and for cross-checking between different price collections.

Product with a local and foreign currency price

6.34 In some countries there are some outlets which sell products in local currency and foreign currency i.e. a purchaser is given an option to pay for an item either in local currency or foreign currency.

6.35 The local currency price is used when purchases are made in local currency.

6.36 However, if purchases are made in foreign currency, the foreign currency price is converted to local currency using the foreign currency exchange rate obtained from a representative sample of appropriate dealers in the foreign exchange market as in the previous example.

6.37 In the event that more items are sold in local currency or vice versa, the enumerator has to ask the shop owner which currency is being used more frequently for making purchases. The currency which is used more frequently in purchasing the item is the one which is used for pricing purposes unless purchases are frequently made in both currencies in which case the price in both currencies is priced and a weighted average used after conversion to the local currency.

Dual pricing for cash and credit or debit card purchases

6.38 Some outlets may sell goods at different prices depending on whether the item is paid for in cash price or if a cheque or a bank debit or credit card is used.

6.39 The main aim is to achieve representativity and continuity. The price collector should ascertain the proportions of people who pay by the different methods and this should then be used to judge what prices need to be collected to ensure that the prices entering the CPI are representative. If the price collector collects a price based on cash payment during a particular month then a price based on cash payment must be obtained in the following month.

6.40 Likewise, if a price collector gets a price based on cheque payment during a particular month then a price for a cheque payment must be recorded in the following month.

6.41 If a price is collected based on the swiping of a bank or credit card during a particular month then the price collector should get the price based on swiping a bank debit or credit card in the following months.

Unavoidable costs that are not part of the advertised cost

6.42 Some goods are sold in a manner whereby the consumer has no choice but to pay an extra cost, in addition to the advertised price of the product itself, in order to obtain the use of the product. In cases where most customers will treat and pay this cost as part of the purchase price, it is sensible to add the extra cost to the advertised price in order to determine a suitable price for CPI purposes[15].

6.43 A common example of this situation is the sale of large household appliances and furniture. The majority of consumers would not be able to provide their own transport to carry these products home. As a result, many stores arrange delivery to the customer's home for an additional cost. It can be argued that when most of the customers must pay for the delivery service, it makes sense to include this charge as part of the purchase price for CPI purposes. The concept still applies when the transport is provided by another stall or business. In this case the cost of transport would be priced separately but added to the cost of the appliance when the index is being compiled.

6.44 A similar situation can occur in marketplaces when live poultry is bought for meat. If consumers regularly buy live fowls and then go to other stalls to have the fowls killed and plucked then the two purchases can be combined to calculate the cost of buying poultry meat.

Bargaining

6.45 Bargaining is where the transaction price is negotiated between buyer and seller. The final price and quantity are not known until the purchase has been made. In many countries, a wide range of daily purchases, especially food, must be purchased in this manner. As these purchases can make up a large proportion of household purchases, price collectors must visit these markets and attempt to obtain true transaction prices.

6.46 With no prices displayed, the price collector has a number of options:

i. *Ask the price from the seller*. There are a number of potential difficulties with this approach. Some stallholders will not co-operate with "government employees". Others will not give a true final price. In some cases any price given will apply to a bundle of produce (e.g. leaves) or to a large piece (such as a fish). But the collector needs a price per kilo. If the collector has a portable weighing scale, and the stallholder allows it, the product may be weighed and the collector can then calculate the price per kilo. But this depends on the stallholder co-operating.

ii. *Ask the price from a recent shopper*. This method involves surveying shoppers as soon as possible after they have left the outlet. It requires the accurate reporting of the quantity and quality of the product purchased, as well as the unit price. Some incentive may be necessary to ensure co-operation.

iii. *Behaving as an ordinary customer and buying the product*. This may, at least in principle, be the best method, but it has a number of serious drawbacks. First, the collector must haggle just as if he or she were an ordinary customer, but as it is not a personal purchase an incentive may need to be given to get the best possible price. Second, the stallholder will come to recognise the collector and realise that he or she is not a genuine customer. Third, the collector must carry away the products. Fourth, funds must be available for the purchases, and an acceptable procedure in place for the disposal of the purchased items. The price collector's own skill in bargaining may heavily influence the prices actually collected, so it may be necessary to have more than one collector bargaining in this way, and then use the average or median price in the compilation of the index.

Purchasing of products in the markets as the means of determining a transaction price can become very expensive. Actual purchases should be kept to a minimum and only done when necessary to obtain a realistic price. One way of reducing this cost, where permissible, is to consider reselling the products to staff after they are no longer needed for CPI purposes (after taking them back to the office to weigh etc.). This would raise money to be used during the next price collection period. However, this would have to be done openly with some checks and balances applied to ensure that no corrupt behaviour occurred.

[15] In most situations the delivery service is optional, and charged separately. If so the price for the good and the price for the service should be recorded as prices for two distinctive items. Of course, if the charge for the delivery is not separable from the price of the product then one combined price should be recorded but the specification should change form "product" to "product + service". In other words, the decision on whether to combine the two prices or not will depend on the specification and should be reflected in the specification.

Table 6.1 Example of a survey form showing the number of price quotations by shop or stall

Items	Targeted number of quotations *(set by head office)*	Actual Number of Quotations		
		Shop/Stall 1	Shop/Stall 2	Shop/Stall *n*
Item 1	*5*	*0*	*3*	*5*
Item 2	*4*	*4*	*5*	*4*
Item 3	*8*	*5*	*8*	*8*
....				
Item *k*	*5*	*7*	*2*	*6*

Collecting prices in a market can be an unstructured process which is difficult to fully plan for in advance because of, for instance, missing goods and differences in quality between different stalls. For this reason price collectors should keep track of how many prices have been obtained from stall holders or customers from each stall and each item. A sample form designed for this purpose for recording the number of prices by stall and taken from the CPI Manual is presented in Table 6.1.

iv. *Ask the price from a supplier to the market*. This involves a regular survey of wholesalers. This approach could be considered to represent a departure from standard CPI price collection procedures. The experience of countries which have tried this method suggests that it should not be relied on as a substitute but as a supplement to normal retail price collection because of the difficulty of converting wholesale prices into retail prices. Ideally, prices should be obtained from the wholesalers who actually supply the relevant retailers. Provided certain conditions are met (such as unchanged taxes, transportation costs, licence fees or rental for the market stall) the trend of wholesale prices may be used as a proxy for the movement in the retail prices of the products concerned. Wholesale prices cannot replace retail prices but assist in determining a realistic price movement when checking the validity of observed price movements or to provide supplementary observations when too many retail prices are missing.

6.47 It may be necessary to use a mixture of some or all of the above methods in order to obtain a reliable sample of prices. Paragraphs 6.92-6.102 of the CPI Manual provide a good deal of detailed advice.

Informal "bonuses"

6.48 An additional issue often faced by price collectors in markets is the informal "bonus", whereby either the stallholder refuses to bargain on price for an individual purchase but will provide a little bit extra (for example, by adding a few more greens to the "heap") or in return for buying a variety of items will offer the shopper some extra quantities or an extra item. This has some similarity to the "2 for the price of 1" offer in supermarkets (see earlier section) except in one very important respect - in developing countries the shopper is likely to have actively haggled for the bonus amount or items, because they wanted the extra quantity, so that there is a genuine discount which should be covered in the CPI. The argument is particularly compelling where people are living at subsistence level. Paragraphs 6.99-102 of the CPI Manual provide a detailed example of how such cases can be treated, based on market values. Another example is given below.

6.49 Where a stall holder gives the purchaser extra quantities as a bonus, the method of determining the price is as follows. A purchaser, in this case the price collector, sets out to buy 5kg of yams, is offered 5kg for $20 and after a lot of bargaining is offered 5kg of yams at $15 and then after further bargaining is offered a free "bonus" made up of 500g of yams and 1kg of "greens", making a total purchase of 5.5kg of yams and 0.5kg of "greens" at a total cost of $15. Since the price collector cannot bargain for the purchase of 500g of yams and 0.5kg of "greens", the estimated value of the bonus is worked out from what the goods would have cost if they had been bought separately under the same bargaining conditions and with the same percentage reduction from opening offer to final price after bargaining. The opening offer price for yams is $4 per kg and the final "price" $3kg, a reduction of 25%. Suppose that the price collector ascertains that the opening offer price for "greens"

from the same stall holder would be $2 per kg. Then it is assumed that the final offer price will be 25% less, i.e. $1.5 per kg. From this the market value of the additional quantities given free can be calculated. For greens this is $0.75 for 0.5kg. This represents the value of the bonus "greens" to which should be added the value of the bonus quantity of yams, i.e. $1.5 (0.5kg at $3 per kg). Thus, the total value of the free "bonus" is $2.25 and the total value of the vegetables obtained by the purchaser is $17.25 at a total price of $15. This represents an average discount of 14.3% ($2.25/$17.25). So the discounted price of 5kg yams is $15 less 14.3% i.e. $12.86. If the price collector is unable to get from the stall holder the opening offer price for "greens", this can be obtained by surveying the opening prices of other stall holders.

Problems sometimes encountered

Regular prices advertised as sale prices

6.50 In some outlets prices are indicated as sale prices but in fact are regular prices if compared with previous prices. In such cases price collectors should indicate the type of price as indicated by the retailer, i.e., sale or regular and report the price as is.

No price on item or shelf

6.51 A difficulty for price collectors is to collect prices in outlets that are poorly organised. In these outlets clothes may be stacked closely together, bundled in a bin, or appear on shelves with no prices. In such cases price collectors should enquire from shop assistants what the correct prices are. However, price collectors should take heed of shop assistants that do not always know what the correct prices are or are unwilling to assist. Price collectors may rather request information on uncertain prices from shop owners or scan the item at the pay point if possible. This also applies to determining the availability of an item, including seasonal items.

Shop assistant insists on giving price with no checking by collector

6.52 Price collectors face many challenges to obtain accurate prices. There are respondents that insist on providing the prices and will not allow price collectors further access. Price collectors receive prices from these respondents but often sense that the prices are not correct. An example would be that the respondent insists that no change in prices have occurred over an extended period of time. In all cases where price collectors are uncertain of the accuracy of prices they should record the prices as received and report the incident so that staff at Head Quarters can decide on forward action.

Frequency and timing of price collection

Frequency

6.53 Decisions about the frequency of price collection are governed by several factors. The most important are the volatility of prices, the types of market from which the prices are collected, the known regularity of price changes, and the frequency and method of calculation of the CPI. These, and other factors, are discussed in detail in the CPI Manual, beginning at paragraph 6.5.

6.54 To accommodate the broad range of users, the CPI is usually calculated at least once a month but calculating the index monthly does not necessarily mean collecting all prices every month. Each item should be priced as often as is necessary to ensure that a reliable index can be calculated. For instance, the prices of some products (such as fees for government services, utilities, tickets to seasonal sporting events) might change only once or twice a year at a regular point in time. When it is known with reasonable certainty when prices will be reviewed by retailers or service providers, prices need be collected only when they are actually due to change. During index periods when the price will not change, the existing price can be used for index calculation. However, it is advisable for the price collector to occasionally check that the assumption of regular and predictable reviews still holds. For products which exhibit a relatively low degree of volatility, such as housing rent and medical services, prices may be collected on a quarterly basis. In contrast, the prices of products with volatile prices might have to be collected more frequently than the frequency of index calculation and publication (see Chapter 9).

Point-in-time or period price collection

6.55 Before a timetable for collecting prices can be drawn up, a decision has to be made by the National Statistics Institute as to whether the index will be calculated from prices covering the whole period (e.g. a month) or from prices relating to a particular time within the period (e.g. three days in the middle of the month). In practice, this decision will be based on a number of potentially conflicting factors such as the main uses of the CPI, available resources and the pattern of price movements. For example, it might be argued that, in principle, if an index is to be used with other economic statistics then the period of coverage for price collection should match the

period of coverage for the other statistics to ensure comparability. For instance, most expenditure statistics will refer to expenditure over the whole period rather than expenditure on a particular day during the period and so the price index should reflect average prices over the whole period. However, spreading price collection over a period of time will smooth out changes in inflationary trends and may make analysis and interpretation of short-term movements more difficult. For instance, when oil prices are volatile the full impact of a price rise in petrol will generally not be reflected in the current index and the contribution of the petrol price increase to the current annual inflation rate and the change in the inflation rate since the previous month will be difficult to calculate[16].

6.56 The point-in-time or period is normally chosen to represent a pre-specified reference period, normally the calendar month in which the price observations take place.

6.57 The relative merits of point-in-time and period price collection can be listed as follows:

- Point-in-time price collection
  - This better facilitates analysis of inflationary trends, in particular the estimation of contributions of specific observable price rises, such as petrol, to a change in the annual inflation rate.
  - But finding a "typical" shopping day can be challenging. For instance, collection day should:
    - Avoid a week which includes a public holiday, because outlets may be closed or charge abnormal prices.
    - Avoid pay days where some prices might be artificially inflated.
  - Also from an operational perspective the associated uneven workloads can be inefficient and have a negative impact on price collector performance at peak times. For instance, a large price collection team will be required for a short length of time in each collection period. This has implications for the recruitment and deployment of price collectors and also for management of the fieldwork. Communication and planning between collectors and their supervisors to manage events like absence due to illness must be prompt and effective. Staff at Head Quarters will similarly be confronted with a heavy workload of data checking and editing of price data over a short period of time.
- Price collection over a period
  - This will be more consistent with some other economic statistics, most particularly the national accounts.
  - The price of some products can be expected to change regularly over time during the collection month. Spreading the collection of prices from different outlets for particular products over the month is a practical and cost-efficient way of obtaining a set of prices representing the whole month. By spreading the visits to different outlets among each week within the month, more price movements that occur during the month will be covered. Each outlet must be visited during the same week of each month.
  - There is a more even workload, thus avoiding some of the operational problems associated with point-in-time price collection.
  - But collecting prices over a period involves collecting sufficient price quotations to obtain a reliable average price level for each product over the period. Products with more volatile prices will generally require price quotations to be collected more frequently during the collection period. It is important that price collection is strictly limited to the price collection reference period (for example, one particular week), regardless of whether point-in-time or period price collection is adopted. This is to ensure the uniformity of the price data, particularly for products subject to frequent price changes. This is especially so in periods of high inflation.

6.58 For both point-in-time collection and period collection, the choice of day, week or other period, will depend on operational considerations. Price collection day is usually chosen with a view to publishing the results of the CPI shortly after the reference month. For instance, if the goal is to publish the CPI two weeks after the reference month, then to allow sufficient time for data processing and editing price collection may need to

[16] On the other-hand, in order to improve public confidence in the index, and demonstrate that the index measures the current price changes in a timely fashion the NSI may consider the possibility of spreading the price collection over a month for items where the price can be volatile, such as petrol. There are arguments both for point-in-time estimates and for spreading price collection across the month.

take place on, say, the second Tuesday of the month for a point-in-time collection, or during the first three weeks of the month for a period collection.

6.59 It is strongly advised that price collection dates are not published in advance. This is to avoid the risk that some service providers or retailers change their prices or time price changes in order to influence the index.

The importance of adhering to the same price collection schedule each month

6.60 A CPI is constructed from price relatives. The collection of a particular set of prices at a particular outlet should occur at the same time of the day, same day of the week and the same week of the month in each collection period. Doing this will ensure that any observed price movements will reflect true movements in the price level rather than price changes resulting from temporary changes in selling or buying behaviour. For instance, buyers might have a tendency to buy certain products only at the end of the week after they receive their wages. Sellers can take advantage of this and keep prices higher than average during the busy days of the week while reducing prices during the least busy days. Collecting prices on the same day of the week for each collection period and in each outlet is essential in such situations. Examples of this behaviour might be the purchasing of leisure services (e.g. restaurants, cinemas). In some countries, mid-week prices are cheaper than weekend prices for these types of service.

6.61 A particular issue arises with fresh produce sold from market stalls. Sellers often reduce prices towards the end of the day to ensure that all stock is sold, especially if there is no practical means of storing the produce overnight and the freshness of the products has declined, indicating a reduction in quality. If consecutive prices are not collected in the same circumstances each month - for example, before the prices are reduced - the movements in observed prices cannot be guaranteed to measure the 'true' price movement between the two periods based on a like-for-like comparison. Also it can be argued that late-in-the-day reductions are clearance prices relating to spoiled produce which should not be priced (see earlier reference to Special Offers).

6.62 Item and outlet replacement are common occurrences during price collection and impact on the ability to compare like-with-like. These issues are discussed in detail in Chapter 7 on Substitution and Quality Change.

Practical collection procedures: planning and organisation

6.63 This section looks at the planning and organisation required for successful price collection. Actual processes will vary between countries but the same general principles apply. The next section gives advice on practical collection procedures in the field.

6.64 For the sake of simplicity, the discussion is based on period pricing rather than point-in-time pricing (see earlier references). This does not mean it is the preferred method. It is merely that one method has been chosen for the sake of brevity and consistency. The concepts discussed will generally apply to both collection methods. Any significant variation necessary to manage point-in-time pricing is mentioned.

6.65 The procedures governing the collection of prices have not only to cover the requirements of obtaining usable prices from the outlets but also the practical problems faced in managing travel to and from the various localities, and validation of information back in the office. The overall operation can only be achieved by cooperation between the price collectors and their supervisors.

Planning the collection schedule

6.66 The collection schedule should include sufficient time for a collector to travel around all required localities within a reasonable number of working hours in a day. Times of travel might be limited in order to arrive at a remote rural market with sufficient time left to obtain all the required prices before the market closes. Allowance will also need to be made where collectors have to share common resources such as the use of an office car. In addition, a price collector needs time to perform all the necessary checking of prices and to answer queries from the supervisor or Headquarters, where necessary re-visiting the outlet concerned. The collection schedule also has to allow for the movement of information and forms between the collection centres and Headquarters. If paper forms are being posted or hand-delivered, sufficient time must be allowed to ensure that all information reaches its destination by the required deadline. If electronic transmission of data and forms is used, then only a little time has to be scheduled for this activity

6.67 Public holidays can occur on days that would otherwise be price collection days. In general, prices due to be collected on the holiday should be collected as close as practicable to that day. This usually means adjusting the regular price collection

schedule for the immediately preceding or following few days. Any adjustments to the preferred regular schedule should be made in such a way that prices reflect the normal pattern of buyer-seller behaviour.

6.68 The supervisor must discuss all these problems with all price collectors for the region to enable collection schedules to be drawn up that are practical and meet the requirements of everybody involved, as well as complying with the price collection protocols for the CPI.

6.69 It should not be assumed that it is best for the collection itinerary to begin from the locality of a collector's home.

Dealing with queries: enquiry management system

6.70 Price collection queries need to be dealt with in a timely and efficient manner both because of the tight schedules associated with the compilation of a CPI and because of the fact that it is very difficult to correct errors in pricing retrospectively. The progress in dealing with queries needs to be monitored and the system for monitoring must be simple, if it is to be effective and flexible to the needs of the CPI production cycle to the problems which arise. An enquiry management system should be able to monitor progress and provide an effective audit trail. Information recorded is likely to include: date received and who from; date due; received from; collection date/trip/period (if applicable); current progress (with date); date completed; date response sent. It is particularly important that decisions are recorded and signed-off.

6.71 The information gathered should also feed into a Quality Management System (see Chapter 15).

6.72 A simple system might use emails to send the query. As these will be seen and read they satisfy the notification requirement. A template form requiring simply ticks and dates to be entered could be created in a spreadsheet and a new copy printed for every collector each collection period.

6.73 The enquiry management system can be either paper or electronic. The two methods should be matched to the resources and infrastructure available. For instance, messages to and from price collectors to their supervisor might be on paper but messages between a regional office and Headquarters could be by email.

6.74 The raising of queries about collected prices is a two-way process. Queries can originate from the price collector, the price collection supervisor or from compilers and analysts in a regional office or at Headquarters. Queries from the supervisor are more likely to be about the accuracy of prices and other information obtained, and are likely to be received shortly after collection. They are also likely to require an answer quickly, before price data are forwarded to Headquarters. Procedures have to be in place that will make the existence of these queries quickly known to the collector. Similarly, reporting of a response has to be quickly made known to the supervisor.

6.75 Queries from regional offices are likely to involve matters such as explanations of extreme movements and inconsistent price behaviour within the region. Again, rapid response will be required to enable the data to be forwarded to Headquarters within the required deadline.

6.76 Queries originating from Headquarters are more likely to be concerned with the representativity of the information rather than the simple accuracy of the information. They will also be received some time after collection has occurred. Because they are received late in the overall processing cycle for index production, the allowable response time is likely to be short.

Practical collection procedures: collecting prices in the field

Price collection and price collectors

6.77 There are two practical means of recording price information obtained from personal visits: paper form or hand-held computer. Both methods need to provide the price collector with all the information required to successfully collect prices. The information collected should include:

- Collection date and collector's name.
- Name or location of the particular outlet.
- Product name and specification of the actual item to be priced.
- Price entry.
- Price movement reason code.
- Price collector comments about the product or price movement.

6.78 The optional inclusion in the form of the price collected in the previous period raises concerns that the price collector may be inclined to automatically record the previous price or be too influenced by it when identifying the item in the outlet to be priced, but it is sometimes included to assist the collector in ensuring that the correct item and price are being recorded. It will help if the price collector adds additional information to the standard description.

This extra information could include descriptive categories such as: brand, make, size, model name and number, reference number, distinctive features and location in outlet (for example, "bottom shelf at rear of shop").

6.79 For fruit and vegetables, weight and quantity information should be part of the item name and full description but it is also essential to record the amount actually priced so that a unit price can be computed.

6.80 Items should appear on the form in such a way that the collector is quickly able to identify and read all necessary information about each item. The order in which the items appear on the form is very important for efficient price collection. As far as possible, they should appear in the order in which the collector expects to find them in the shop. Especially with paper forms a correctly ordered list will reduce time-consuming swapping and searching between pages. Even with a hand-held computer there will be less time-consuming searching and pressing of navigation buttons if the item list is ordered so as to match the shop layout. An example of a typical price collection form is given in Appendix 6.1.

6.81 No matter which form of collection is used it is essential to provide some procedures to allow the tracking of activities and formal sign-off confirming that processes have been completed and necessary actions undertaken on data checking and the transfer of information to Headquarters. Audit trails are essential for work and quality management.

6.82 Completion of the price collection forms, whether by paper or electronically, should comply with the following guidelines:

- All prices should be entered into the collection sheet in full even if there is no price change. This is good practice as it helps to ensure that the correct item is being priced. A price should never be recorded as, for instance, 'No change'. All other entry fields on the price collection sheet should have something entered if only to indicate that they were not accidentally missed, for instance, "NA (not available)".
- If a price is not available a reason must always be supplied. The information given will be useful to the collector's supervisor and the index compilers as well as to the price collector during the next collection period. The price collector may need to ask the shopkeeper for an explanation.
- All information should be entered on the collection sheet as soon as it is obtained and

Table 6.2 Examples of price collection codes

Collection code	Description
C	Comparable - A replacement item that is comparable to the old item in all major aspects.
DC	Drop confirmed - A price drop that has been checked and confirmed by the price collector or shopkeeper
M	Missing - The item is no longer available and is unlikely to return. There is no suitable replacement item.
N	New item – A replacement item that is not comparable to the old item but is still considered representative.
R	Recovery – A price rise back to a normal level, following a reduced sale or previous special offer price.
RC	Rise confirmed – A price rise that has been checked and confirmed by the price collector.
T	Temporarily out of stock – The item is unavailable this time but is expected to be available again in the near future.
W	Weight – A permanent change in the weight or quantity of the item has occurred.

not entered later from memory. This applies as much to explanatory information as to prices. Shopkeepers and stallholders will appreciate the need for accuracy and can be asked to allow the collector a moment to record the response. As well as ensuring the accuracy of the information, prompt recording also ensures there is no confusion with regard to the source of the information.

6.83 Collected data should be checked as soon as possible. Price collectors should check that prices have been collected for all items on their collection sheets or recorded as unobtainable. Preferably this check should be performed before the collector leaves the outlet as otherwise any missed prices have to be obtained by a return visit which will need to be made as soon as possible. Apart from the inconvenience and cost of making a return trip at a later date, there is a risk that prices will have changed since the regular visit. Price collectors should also check before leaving the outlet that any exceptional price movements have explanations recorded.

6.84 Using codes to indicate various situations encountered while pricing will make recording of the information more efficient. Not only will recording be quicker but the use of codes will impose consistency in explanation between price collectors. The codes will also help price collectors to appreciate what information is of interest to the index compilers. The codes should cover situations faced regularly while price collecting: such as a special offer price, recovery price after a sale, price movement has been confirmed, permanent quantity change or temporarily out of stock. A sample of what these codes might include is given in Table 6.2.

6.85 As mentioned earlier, Structured Product Description (SPD), or similar coding frames, can be used to capture item characteristics to enable the Price Collector to identify the exact item to price in future months (see Appendix 6.2 for an example of an SPD and an SPD form). SPD forms, which supplement price collection forms, are completed in the following cases:

- *Initiation*. Where a SPD form is completed for an item for the first time. For example, assume the price collection for a kettle needs to be initiated and it is found that *Safeway* kettles are the volume seller. A *Safeway* kettle will be initiated by completing a SPD form. All the item characteristics of the *Safeway* kettle should be captured on the SPD form and in future months the *Safeway* kettle should be priced.
- Substitution. Where substitution of similar products occurs to replace items that have become permanently unavailable (I.e. items reported as "Permanently unavailable" on the previous pricing form). Assume that *Epol* dog pellets (8 kg) are currently priced (having been previously initiated) but are now no longer be sold by the outlet and will need to be replaced with a similar item, for example *Dogmor* (8kg). An SPD form will be completed for a substitute item upon the next visit to the outlet.
- *SPD revision*. This is where the detailed features of a product currently being priced has changed, for example the size changes.

Field supervisors

6.86 Supervisors should regularly check that price collectors are adhering to the price collection schedule and are undertaking the required checks at the appropriate time. The supervisor should check that price collectors are completing price collection sheets correctly. A sample of collection sheets from each collector should be checked where it is not practical for supervisors to check every sheet. Checks may be made, for example, on whether the price collector has attempted to collect all prices from all outlets, that explanations have been given where prices were not obtained, and adequate descriptions entered where replacements for disappearing goods have been priced. The supervisor may also be required to check the accuracy with which data are transferred from paper to the computer. This is an essential task associated with the quality assurance process and needs to be allocated to somebody other than the person who initially input the data so that an independent check can be performed.

6.87 Supervisors should also be encouraged to visit shops and check the individual prices collected by price collectors. This can be organised either on a random basis or chosen on the basis of indicative information, such as extreme price variations, which suggests that a particular price collector may be experiencing difficulties. An example of a typical audit report completed by a supervisor after price checking in the field is given at Appendix 6.3. This should be followed up by a formal request to the price collector asking for corrective action and confirmation that all necessary follow-up actions have been carried out.

6.88 Field supervisors should check for consistency and credibility in price movements recorded by all the collectors under their control. If, for instance, one locality is reporting different price movements from the other localities within the collection region

some explanation, or a follow-up price collection, will be required to check the accuracy of the prices collected. Preferably this should be done once data have been entered into the computer system and have been checked for transcription errors. To enable the supervisor to conduct these checks efficiently the computer should provide various tabulations of price changes grouped by product or elementary aggregate. This will enable the supervisor to quickly identify extreme or inconsistent movements. Extreme or inconsistent movements may indicate either errors in collection or unexpected behaviour in the market. These checks should be conducted regularly during the price collection period.

6.89 Data checking procedures at Headquarters are discussed in Chapter 12 on Data Validation.

Training and work instructions

6.90 The training of local price collectors is a vital element in ensuring the quality of the prices data and of the CPI. Collectors need to be properly trained, require adequate instructions and easy access to guidance, particularly so given the facts that:

- Price collection is not a trivial matter.
- Snap judgements often need to be made.
- Collectors often work remotely and on their own.
- Instant communication is not always possible.
- Collectors work in a dynamic environment.
- It is difficult to rectify errors after the event.

6.91 The CPI Manual states, in paragraph 6.124, that "Documents are needed to explain what is to be done, when it should be done, how it should be done and why it should be done". Reviewing the documentation also provides an opportunity to review the procedures.

6.92 The issue of good documentation as part of an integrated quality management system is addressed in Chapter 15. This section of the Handbook deals specifically with the documentation needs of price collectors. But first it considers training.

6.93 The training of price collectors should enable them to successfully perform all essential activities and deal with all potential situations including not just recording the price of an item but, for example:

- Persuading new outlets to become price providers.
- Understand and recognise occasions when prices provided are unacceptable.
- Recording relevant information to describe quality change in a product.
- Recognising unusual price movements when checking their collected prices.

Induction training

6.94 Induction training should be compulsory for all price collectors so that they gain the necessary skills before collecting prices for the CPI. It can also be a motivational tool. It should be delivered by the National Statistics Institute and ideally include contributions not only from those supervising the fieldwork but also from Headquarters staff involved in the compilation of the CPI. The latter are best placed to convey data requirements and to put price collection in the broader context of compiling the CPI. Also, by helping to train price collectors, compilers can gain useful practical knowledge about pricing.

6.95 A typical training schedule might consist of a one day training course at Headquarters (which may include some refresher training for experienced collectors). This should include:

- Background to the CPI and the National Statistics Institute.
- Use of the CPI and importance of accurately recording prices.
- The general principles of index compilation and price collection.
- How local price collection fits into the process.
- Retailer recruitment, getting permission to enter shops etc.
- Practical price collection issues. For example: product identification/descriptions; pricing (item descriptions, definition of price/sale price, rules relating to seasonal items, quantity conversions, quality adjustment - when is an item or product equivalent?).
- The timetable and administrative arrangements.

6.96 Practical examples and practice collections should be an integral part of the learning process. For example there should be an opportunity for:

- Discussions about "equivalent" replacements using photographs and item descriptions.
- Practice collections in office.
- Supervised practice collection in the field.

6.97 Tests and evaluation of individual performance should be an integral part of the training. This could be through:

- Written tests at the end of induction day.
- Evaluation by supervisors of practice collections in field.
- Feedback to new collector - including additional training needs.
- Evaluation by collectors of training provided (essential for ensuring training is relevant and effective)

6.98 The evaluation of individual collector performance is essential. Collectors must pass the required standards before being allowed to conduct a real collection.

Follow-up training

6.99 The longer-term element of training is just as important as induction training to the integrity of price collection. To ensure that the appropriate price collection standards are maintained it is recommended that within six months of the initial training the price collector's supervisor:

- Accompanies the new price collector on a live price collection.
- Conducts a back-check of the prices collected to identify any problems.
- Produces an evaluation report which will provide a basis for further training.

6.100 In addition, it is recommended that regular accompanied checks and back-checks for all price collectors are conducted, as well as special checks for poorly performing collectors.

6.101 A good training programme will also help to motivate price collectors.

Refresher training

6.102 Regular refresher training workshops should also be held. These present an opportunity to: raise awareness of the importance of getting correct prices; provide formal training on revised guidelines; resolve recurring or recent problem issues; provide price collectors with an opportunity to assist each other in managing problem situations encountered in the field, such as dealing with reluctant respondents.

Training of supervisors

6.103 Supervisors must be at least as well informed as the price collectors. As the supervisor will normally be the first point of contact when a difficult situation is encountered during price collection, they also need a good understanding of the methodology and theory behind the selection of the product sample. Supervisors are also part of the management team. Their training should cover such matters as:

- Team management.
- Performance appraisal (where this is normal office practice).
- Project management.

Headquarters staff

6.104 Headquarters staff should also be provided with a basic training in price collection. The benefits are three-fold:

- It gives Headquarters staff a better understanding of collectors' needs.
- It helps editing (staff at Headquarters will know what to look out for).
- It supports Disaster Recovery (Headquarters staff will be able to undertake price collection in an emergency)

6.105 Further advice on training and the monitoring of performance is given in Chapter 15 (Organisation and Management) in the broader context of quality management systems.

Documentation

6.106 Accessible, relevant and up-to-date work instructions are essential both for price collectors and their supervisors. Documentation should cover all aspects of the job and should in large part reflect what has been covered in training.

6.107 Price collectors should be provided with work instructions on:

- How to approach shopkeepers.
- How to ask questions to ensure that the required information is obtained.
- Appropriate personal behaviour and dress codes.
- Procedures for recording and passing on collected prices and other relevant information.
- Data checking.
- Creating collection schedules.
- Recognising when recorded prices are apparently wrong.

6.108 The work instructions for supervisors of price collectors should be in the form of a supplement to

the price collectors' work instructions and should cover:

- Checking the quality of the price collectors' work.
- Checking the accuracy and completeness of the prices collected.
- Official recording of resource use (for example, cars and bicycles for transport and funds for buying goods in markets).
- Official procedures for maintenance of resources (for example, testing the accuracy of scales).
- Creating complementary collection timetables for all collectors within the supervisor's area of responsibility.

6.109 Most of the documentation should be prepared by Headquarters, with input as appropriate from regional offices and fieldwork supervisors. Centrally prepared documentation will help ensure consistent practices in the field including between regions. It should be readily available to all collectors and supervisors. The documents could be available in paper or electronic form, whichever suits the organisation, but whichever medium is chosen it needs to be accessible to the relevant staff.

6.110 All documentation should be kept up-to-date. With paper-based documentation this could mean keeping the instructions in a loose-leaf folder and issuing individual updates. The amendment pages should include version number and date printed and should be kept to a reasonable number for ease of reference. A judgement will need to be made on when a re-print of a chapter or the complete working instructions is justified.

6.111 Further advice is given in Chapter 15.

Appendix 6.1 Example of a price collection form

Consumer Price Index: Pricing Form - September 2008 — **Confidential**

Collection Period:	WEEK 1	**Collection Date:**	1
Unique Number:	8379435	**Quote** 1 **of** 502	

WOOLWORTHS

Contact Person:	ADRIAAN JOUBERT	**Alt. Contact Person:**	MARISA LOUW
Contact Number:	015 516 2620	**Alt. Contact Number:**	015 516 2620
Product Group:	1101 BREAD		
Product Subgroup:	1101001 (1) LOAF OF WHITE BREAD		

Brand Name:	Woolworths				
Product Name:	Sandwich White Bread				
Quantity:	1 Loaf	**Size:**	700	**Unit Of Size:**	Gram
Observations:	Transparent Plastic Bag With Blue Lines Has An Woolworths Symbol				
Origin:	South Africa				

Code	Feature	Description	Other Information
IK043	Product presentation	Plastic bag	
MN018	Variety	Sliced	

Specification Changes: **Code** **Feature and Description**

Item Availability: AVAILABLE — **Available** ☐ **Out Of Season** ☐ **Temp. Unavailable** ☐ **Perm. Unavailable** ☐

Unique Item Season: ALL YEAR — **All Year** ☐ **Seasonal** ☐ **If seasonal indicate the seasonal months below:**

Jan ☐ **Feb** ☐ **Mar** ☐ **Apr** ☐ **May** ☐ **Jun** ☐ **Jul** ☐ **Aug** ☐ **Sep** ☐ **Oct** ☐ **Nov** ☐ **Dec** ☐

	2008/08	2008/09
Price:	R 7.95	
Type of price:	REGULAR	REGULAR ☐ SALE ☐
Quantity:	1 Loaf	
Size:	700	
Unit of size:	Gram	

LAST REGULAR PRICE	QUANTITY	SIZE	UNIT	COLLECTION PERIOD
R 7.95	1 Loaf	700	Gram	2008/08

Previous Months Comments:

Field Message:

Office Use Only
Unit Status Code: ☐

Appendix 6.2 Structured Product Descriptions and SPD forms

Structure Product Descriptions are hierarchical. The following description follows the format in which the SPD might appear on a price collection form. An SPD form, used to pre-specify the items to be priced, is given at Appendix 6.1.

The SPD heading section

Consumer Price Index: Structured Product Description (SPD) - September 2008					Confidential
Collection Period:	WEEK 1		Collection Date:		
		WOOLWORTHS			
Unique Number:	8379435		Quote	1 Of 502	

The heading of the SPD is Consumer Price Index: Structured Product Description (SPD). The month concerned is also indicated (September 2008). The Collection Period, e.g. WEEK 1 may be pre-printed. The Price Collector should indicate the day on which the SPD form was completed, e.g. 05 as the Collection Date. Prices should be collected at approximately the same day of the month every month from a particular outlet, for comparability reasons.

The SPD form in this example is applicable to Woolworths. The unique number is a unique outlet identifier assigned by Head Office. Quote 1 of 502 indicates that this is the first survey form applicable to Woolworths. The total number of survey forms applicable to Woolworths is 502.

The Contact information section

Contact Person:	ADRIAAN JOUBERT	Alt. Contact Person:	MARISA LOUW
Contact Number:	015 516 2620	Alt. Contact Number:	015 516 2620

This section contains the Contact Person (Adriaan Joubert), the Contact Number (015-516 2620), and the Alt. (Alternative) Contact Person (Marisa Louw) and the Alt (Alternative) Contact Number (015 – 516 2620).

The Brand and Quantity section

Product Group:	1101	BREAD			
Product Subgroup:	1101001 (1)	LOAF OF WHITE BREAD			
Brand Name:			Product Name:		
Quantity:		Size:		Unit Of Size:	
Model Number:		Style Number:		Outlet Product Number:	

The Product Group is BREAD and the corresponding Product Group Code is 1101. The Product Subgroup is LOAF OF WHITE BREAD and the Product Subgroup Code is 1101001. The commodity sub code is (1). This means that this form relates to the first price quote. There is another form with the product subgroup 1101001 (2), which relates to a second price quote. Thus a product subgroup might have more than one quote number and each will have a commodity sub code. This means that for that specific product subgroup, the price collector needs to collect different items that fit to the specific product subgroup. For example, if the Price Collector receives the following forms:

Quote	Product subgroup code	Product subgroup description
011	01112001(1)	Loaf of white bread
012	01112001(2)	Loaf of white bread
013	01112001(3)	Loaf of white bread

The Price Collector needs to look for three different types of loaf of white bread in the outlet that are volume sellers. The Price Collector can initiate three different brands (Albany, Blue Ribbon, and Sasko) from the outlet. It is important for the Price Collector to ensure that the same item is not initiated more than once.

The Brand Name and the Product Name of the selected item should be completed. Also, information regarding the Quantity, Size, and Unit of size, should be completed. Finally, the Model Number, Style Number and Outlet Product Number should be completed, if it is applicable to the item. Appliances, furniture and spare parts often have a Model Number. Clothing has a Style Number. The Outlet Product Number is any unique number assigned by the outlet that will assist in identifying the item in future months.

The Item characteristics section

Item Characteristics:

Product presentation		**Variety**	
Open display		Not sliced	
Paper bag		Sliced	
Plastic bag			
Other (indicate):			

All the item characteristics in this section need to be completed. This section will differ depending on the type of item.

The Origin section

Origin:	Domestic		**Indicate the country if imported:**	
	Imported			
	Not Stated			

The purpose of this section is to provide an indication of whether the item is produced locally or imported from abroad. If the item is imported, the country of origin should be specified. The country of origin must be stated on the item to confirm this. For example, the item must be written, Made in ….., produced in ….., product of …… etc. No assumptions must be made. For alcoholic beverages it must be written "Distilled and bottled in …" and for non-alcoholic beverages it must be written "Bottled in …."

The Further Remarks/Observations section

Further Remarks /Observations:	

In this section any additional comments that may help to identify the item in future months are recorded. For example, comment on the colour of the packaging, the colour of the initiated clothing and footwear, etc. This section cannot be left blank except for items sold loose or on open display.

Appendix 6.3 Auditing of prices: example of monthly audit report

1. Audit information

Applicable Month:	*Month of Audit]*
Province audited:	*Province Audited]*
Region:	*[Region Audited]*
Supervisor/s:	*[Supervisors Name*]
Date of audit:	*[Date]*
Collection period audited:	*Collection period on which audit took place*]
The scope of the audit:	[*Type of audit]*

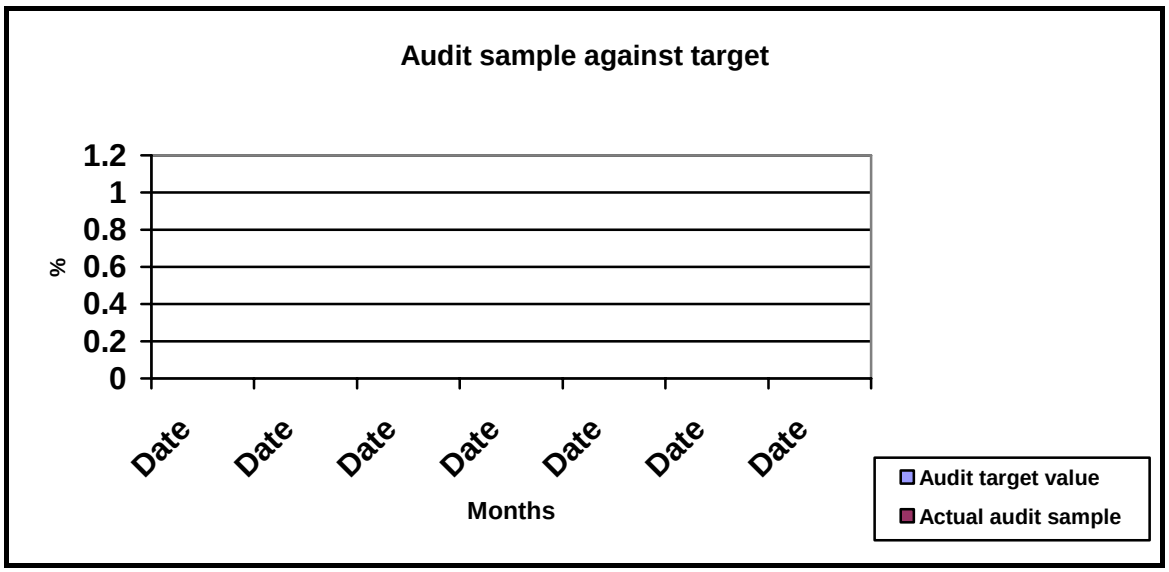
2. Audit sample*: [Province Name]*

Outlet Types	**Quotes completed by price collectors at outlet**	**Sample selected for audit**	**Percentage sample against price collectors sample**
Totals			

Quotes per province	***Province 1***	***Province 2***
No. of quotes completed by fieldworkers in collection period *[State collection period*] (includes zero weights).		
No. of quotes sampled for audit.		
Percentage of quotes sampled.		

3. Audit sample against target:

Target for audit sample *[State target value]*



4. Errors allocated:

Team A*: (Region –Supervisor Name*)

Outlet name	Number of completed quotes	Potential errors	Error Type				Individual potential error percentage per outlet*
			High Impact		Non High Impact		
AUDIT ERROR PERCENTAGE *[Type error percentage]*							

Note: Audit Target value

>0≤5	***Green***	*>5≤8*	***Amber***	*>8*	***Red***		

**The number of total errors are divided by the overall number of potential errors*

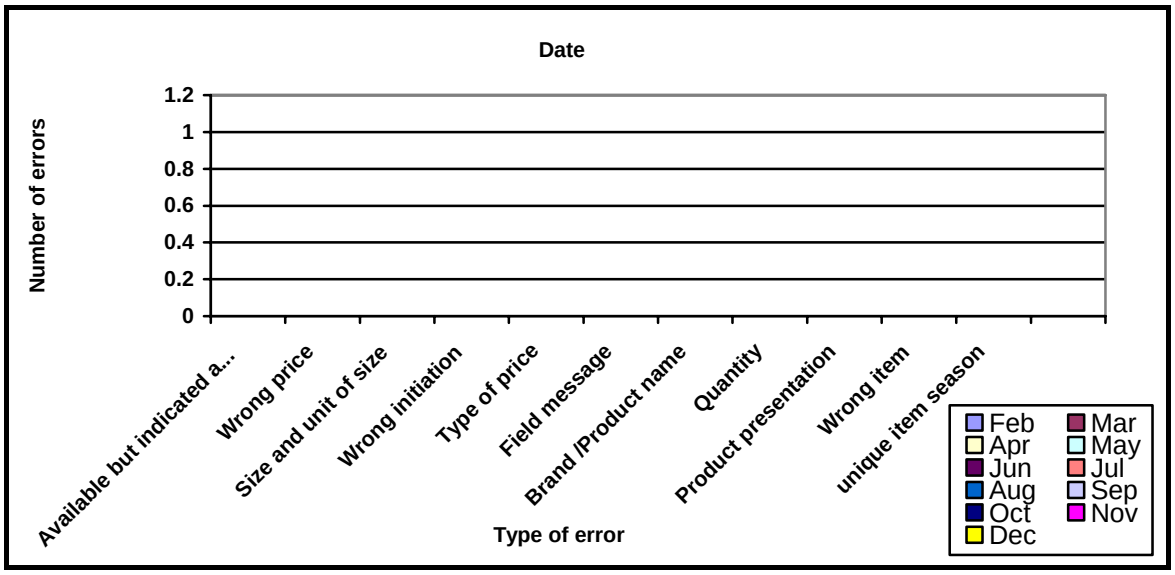
5. Breakdown of findings:

Team A *[Supervisor's Name]*

High impact errors	**Numbers of Quotes with Errors**
Wrong Price	
Wrong initiation	
Wrong Item	
Field message	
Available but indicated as temporary unavailable	

Non High impact errors	
Brand and product name	
Wrong type of price	

6. Error type graphical presentation



Corrections required:

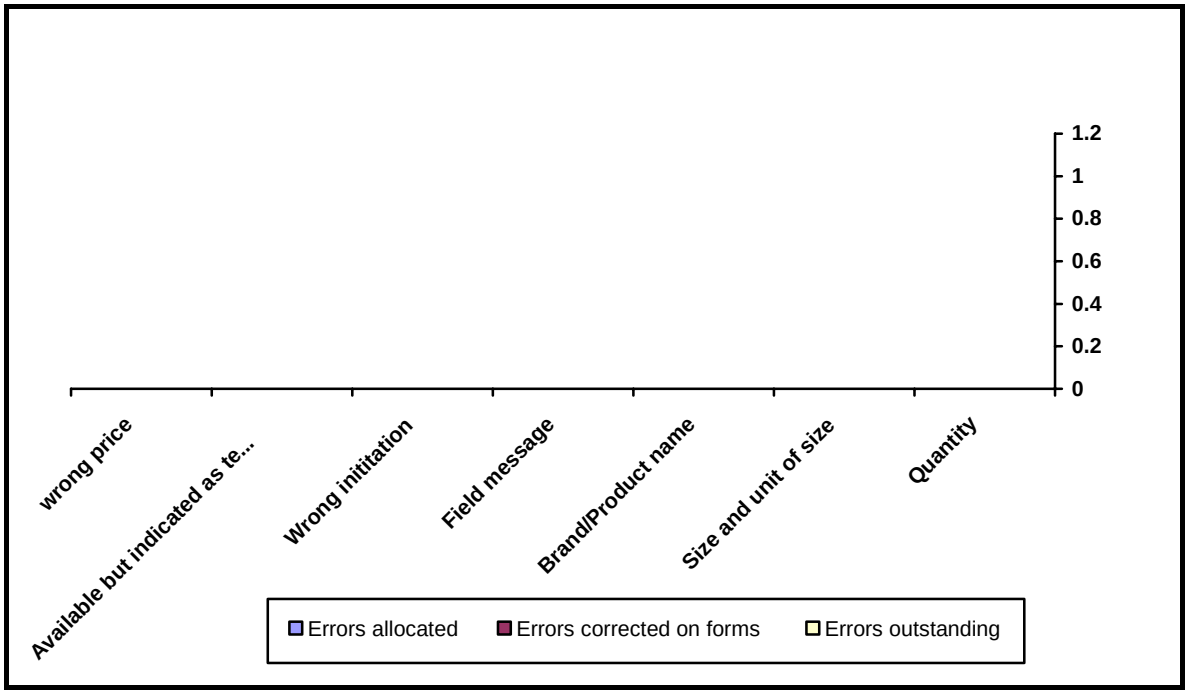
Correction to be effected by	*Next collection period [Date]*
Review quality plan	*Date*
Submission date	*Date*

7. Accuracy:

[Give the status of quality control checks on the audit quotes]

8. Status of previous audit findings:

Regions – [Date of Audit]



9. Discussions with price collectors

[State the outcome of the price collector interviews]

10. General

[Give general comments about the audit]

CHAPTER 7

Substitution and Quality Change

Introduction

7.1 A CPI should reflect the change in the cost of buying a fixed basket of goods and services of constant quality. In practice this represents a challenge to the price statistician as products can permanently disappear or be replaced with new versions of a different quality or specification, and brand new products can also become available.

7.2 Chapter 7 of the ILO Manual discusses the nature of "quality" and methods for adjusting prices for quality change. It provides detailed guidance both on implicit methods of quality adjustment, such as the bridge overlap method and class mean imputation, and on explicit methods including expert judgement, and the hedonic approach. Chapter 8 delves more deeply into the issue of item substitution, particularly on methods of incorporating new products into the index.

7.3 Paragraphs 61 to 67 of the 2003 ILO Resolution advises that when a product disappears "clear and precise rules should be developed for selecting the replacement product". It lists three selection strategies: the most similar; the most popular; the most likely to be available in the future. On quality adjustment it states that "when a quality change is detected, an adjustment must be made to the price, so that the index reflects as near as possible the pure price change". It guards against the automatic assumption that all price change is a reflection of the change in quality". It does not recommend particular explicit or implicit methods of quality adjustment but does state that "the methods used should as far as possible be based on objective criteria".

Background

7.4 To measure price change from one period to the next, the price statistician tracks, for each elementary aggregate, the prices of a fixed sample of items. The detailed characteristics of the products, that is the varieties (both goods and services) selected in the outlet or centrally by Head Office for pricing, are recorded to assist the price collector to fulfil the aim of pricing in consecutive price collection periods exactly the same product in the same shop in the same location so that the CPI compares "like-to-like". Also the recording of detailed characteristics, especially price-determining features, can help when needing to make adjustments to the recorded price due to changes in specification and hence quality. In practice, the particular product being priced in a specific shop may become unavailable - for example, the product is discontinued, may be in temporary short supply or may be a seasonal product which disappears when out of season. The latter situation is a special case and is dealt with in Chapter 9. In all other cases, the price statistician needs to estimate the price of any missing product that he or she believes will return to the market within a reasonable time, or, if the price statistician believes it will not return, find a suitable replacement. When the latter situation arises, the replacement should be either (a) as similar as possible to the previous one or (b) the most popular "similar" product in the shop or (c) the "similar" product that most likely will be available for future pricing. Unlike approach (a) which leaves the sample "static" with the danger that it will be increasingly out-of-date and difficult to collect prices for, approaches (b) and (c) have the advantage of introducing an element of sample replenishment. This is where quality adjustment (QA) comes in. The price index should reflect only pure price changes - the price index should NOT reflect any portion of the price difference that is due to increases or decreases in quality between the missing item and its replacement. A value needs to be placed on any change in specification between the old and replacement item and a quality adjustment applied accordingly. This applies to any replacement strategy, but is particularly relevant where sample replenishment takes place.

7.5 Chapter 5 of this Handbook deals with procedures for making the initial sample selection and covers issues relating to the selection, for local price collection, of representative products or representative items on sale in outlets in a sample of locations chosen to be representative of the country as a whole as well as the sampling of centrally collected prices. Chapter 6 deals with the associated issue of price collection. The treatment of entirely

new goods and how they are introduced into an index is covered in Chapter 8. Methods for dealing with seasonal goods are covered in Chapter 9.

7.6 This current chapter provides guidance on three topics:

- Substitution procedures where an item, product or outlet disappears, including the issue of new items.
- The imputation of a price when a product is temporarily out of stock (excluding seasonal goods).
- Quality adjustment where a change of product involves changes in its price determining characteristics.

Substitution procedures

7.7 In a dynamic retailing environment there is a continuous turnover both in outlets and in products.

Outlets

7.8 If an outlet goes out of business or refuses to participate it should be replaced with the same sort of outlet (for example, a market stall should be replaced with a market stall, a single shop with a single shop etc.) in the same location, and conducting the same type of business (in other words selling the same types of goods). For example, if the previous shop was a butcher selling refrigerated meat, then another butcher selling refrigerated meat should replace it. If probability sampling was used to select the original outlet, the sampling frame should be revisited and a replacement outlet selected from the same stratum. Regardless of how the replacement is found, the original outlet's sampled items should be assigned to the replacement outlet for price observation.

7.9 If an outlet changes location, a decision on whether the price collector should follow the outlet to its new location needs to take into account both sampling and operational issues:

- *Sampling issues.* The principle of maintaining a like-for-like comparison holds. In practice the balance of the sample needs to be maintained in order to ensure that it continues to be representative. Stratification is frequently used to increase sampling efficiency and ensure that the sample is representative. This means that when an outlet changes its location, reference needs to be made to the stratification and selection procedures used in the initial sample selection. For instance, assume that shopping locations were initially selected from local administrative areas, stratified by an urban/rural split and shop type, and then outlets randomly selected from those outlets within the chosen local administrative areas. Then the relocating outlet can be followed to its new location if it continues to fall in precisely the same stratum. However, if the outlet moves away from the original shopping location, for example from an urban shopping district to a rural area outside the city or to another urban district within the city, or if it relocates within the same shopping location but becomes part of a multiple chain, then it has moved to another stratum and a suitable replacement for it should be found from within the original stratum, in order to maintain the sample balance.
- *Operational issues.* As mentioned in Chapter 5 there may sometimes be operational reasons for departing from the sample generated by the standard selection procedures. For instance, efficient scheduling of price collection and the availability of price collectors may make following the outlet to its new location impractical even though it has stayed in the same stratum. Similarly, a visit to the new location may indicate that it is impractical for the collection of prices, for example, because of a physical barrier such as a railway or river bisecting the area and causing difficulties of access.

Products

7.10 If a chosen product is temporarily out of stock and no price is recorded, a note to this effect should be made by the price collector. If it is out of stock for, say, three consecutive months, then the collector should be instructed to choose a replacement which matches as closely as possible the product description unless it is decided to take the opportunity of a disappearing good to update the sample. For a product temporarily out of stock a price has to be imputed. Where a product is permanently unavailable for pricing, procedures need to be in place for determining a replacement and then impute a new base price. Methods for imputing a missing price will be discussed shortly.

7.11 As the issues relating to temporarily and permanently missing products differ - and their treatment is different - it is important for the price collector to establish whether the unavailability of a product is likely to be temporary or permanent. A price may be considered as temporarily missing if

the same product is likely to return to the market within a reasonable time period. This includes seasonal items for which special procedures apply (see Chapter 9). Permanent unavailability, on the other hand, occurs when a variety is withdrawn from the market with no prospect of returning in the same form. Products may be temporarily missing due to supply shortages caused by factors such as the seller underestimating demand, strikes by factory or transportation workers, or supply problems with imported products. In these cases the price collector, although not able to observe a price in the current period, may have obtained information (e.g. from the shopkeeper) to suggest that the same variety will become available again at some, perhaps unknown, time in the future.

7.12 The above discussion does not cover seasonal products i.e., where a product or item may disappear because it is a seasonal product and it may be expected to reappear when it is next in season. The latter is covered in detail in Chapter 9. The problems of imputation are fairly similar for both temporarily missing and seasonal products.

Temporarily (non-seasonal) missing products

7.13 If it is believed that a missing product will be available again in the future then the price statistician has four options:

- *Omit the product for which the price is missing* so that a like-for-like comparison is maintained using matched pairs. The elementary index uses only those observations for which the price collector obtained prices of exactly the same variety in the current and previous periods. In this approach the price change for the deleted product, which was recorded up to the point immediately before its disappearance will be disregarded from that point on. This may cause problems, for example, if it unbalances the sample.
- *Carry forward the last observed price*. Although this provides a price continuity in the periods when observations cannot be made, it is likely that short-term movements in the index are biased, since the sub-indices in question will show no change when prices are not available. If prices in general are rising, the bias will be downwards, whereas if prices are falling, the bias will be upwards. Carry-forward is not recommended, particularly when there is high inflation or when period-to-period movements (as opposed to annual movements) in the price index are important. The carry-forward method is appropriate only if there is reason to believe that the price has not changed. Typically it will be difficult for the price statistician to validate the belief that the price has not changed.
- *Imputation.* Carrying forward a price may be better than simply adjusting the sample composition to ensure comparability (matched pairs) but this is not guaranteed, and can be better than comparing the prices of products which are dissimilar in terms of price-determining characteristics, although this cannot be guaranteed. Nevertheless, the best solution by far is to impute a price. Imputation makes use of the best available information to provide an unbiased estimate of price movement. The principal methods for imputing prices are shown in more detail in Chapter 9 Table 9.2(b) of the CPI Manual. There are essentially two choices:
  - *Impute the missing price by reference to the average price change for the prices that <u>are</u> available in the elementary aggregate (overall mean imputation)*. This assumes that the price change of the missing product, if it had been available in the shop, would have been equal to the average change in prices in the elementary aggregate. This may be a reasonable assumption if the elementary aggregate is fairly homogeneous. This method of imputation is equivalent to the "omit" method (see first bullet point), no matter whether a Jevons, Carli or Dutot method of aggregation is used at the elementary aggregate level.
  - *Impute the missing price by reference to the average price change for the price of a "comparable" item from a similar outlet (class mean imputation)*. This represents a more precise match between the missing product and the products supplying an imputed price. It is normally preferable to imputation using the average price change in the elementary aggregate unless the imputations are unreliable because of small sample sizes.

7.14 A detailed discussion of the latter two methods is presented later in the chapter.

Permanently missing products

7.15 When the situation arises where a product permanently disappears or is replaced by a new

version with a different specification, three actions are required by the price statistician:

- Selecting a replacement product for pricing.
- Quality adjusting the price for differences in quality.
- Calculating a base price.

Each is considered in turn.

The selection of a replacement product for pricing

Rationale for selecting replacements for missing varieties

7.16 In practically every period for which a price index is compiled, some varieties of a product become permanently missing, not just in particular outlets but also because they are no longer produced or imported. If no action is taken, the sample of prices will diminish. The latter is problematic not just because of the potential impact on how representative the sample is but also because it will lead to estimation of price change with samples that do not match from period to period, i.e. the composition of the matched pairs change. In addition, the index number for the latest month will be less reliable than that for the previous month because of the smaller sample size.

7.17 Note also the potential problems with the estimation of average prices and changes in these averages where these are published. For example, using arithmetic averages, if prices for three varieties (A = $3, B = $3, C = $2) were available in the previous period giving an average price of 2.67, whereas in the current period prices are available for two varieties only (B = $3, C = $2), the average price will fall to $2.50 even though none of the variety prices for which prices are available in the two periods has actually fallen. The average price will have fallen purely due to a change in the sample composition, the same also happening when a geometric mean is used. The arithmetic mean example is shown in Table 7.1. Further discussion on the publication of average prices is given in Chapter 14.

7.18 Because of the problems referred to above, the price statistician's task is to maintain the sample size by finding replacements for the specific varieties when they are no longer available and are not expected to return within a reasonable time. One of two alternative strategies can be adopted. Under both options it is important to identify any differences in quality between the original and replacement varieties as it is crucial to ascertain whether there is a quality difference, and, if there is, to estimate its value and calculate a quality-adjusted price.

Table 7.1 Example of incorrect index calculation due to change in sample

Period	Prices of varieties A	B	C	Avg. Price
1	3	3	2	2.67
2	--	3	2	2.50
Price Index (Dutot)	= 2.50 / 2.67 = 0.936 (6.4% fall)			

7.19 *Replace with the most similar product.* This reduces the role of quality adjustment, as the more similar a product is the less is the required quality adjustment (see later paragraphs), but contributes to the deterioration in the representiveness of the sample where a product starts disappearing from the shops because it is being replaced by something new and sales are declining. Finding the replacement that is most similar to the original variety requires knowledge about characteristics of the previous variety. Good practice in price collection involves maintaining up-to-date descriptions of the variety's characteristics. The International Comparison Program (ICP) developed "structured product descriptions" (SPDs) for most item categories: these provide a framework to list the various characteristics — prioritized in order of their importance — of the varieties for each category.[17]. Such descriptions of characteristics can be used to match the characteristics between the old variety and various replacements so that critical characteristics are matched and less important characteristics can be noted. Critical characteristics are those that contribute to the price determination, such as type of product (canned tuna fish), brand (Star Kist), size (150 ml), and packaging (tin, in water). Less important characteristics are those that do not affect the price, such as colour of the label on the package or the location in the shop where the product is displayed. The salient considerations can be incorporated into a decision-making framework for identifying a "similar" product, as follows:

- There is a basic match of the main characteristics, including, and most particularly, those which determine price.
- Consumers perceive them as similar even though some characteristics may be different.

[17] See the ICP 2003–2006 Handbook on the World Bank ICP website at http://go.worldbank.org/MW520NNFK0.

This may be the variety in the shop that buyers are most likely to buy in place of the original.

- They are used for the same purpose and in similar situations. For food this may include a consideration of whether the brand is one for everyday consumption or only for special occasions.

7.20 Under the "replace with a similar product" strategy, an updated version of a product, i.e. the one that the supplier lists as the replacement, is the logical starting point for the replacement for its predecessor. In most instances this would be the one that is the most similar to the original variety, so the price statistician can compare "like-to-almost-like". In instances where the most similar variety is also one that is likely to soon disappear, the price collector should select the variety that is most popular within the outlet for the product class. Although this is less likely to yield a replacement that is sufficiently similar to permit direct price comparison, it will reduce the likelihood of the replacement disappearing in the near future and will keep quality adjustment to a minimum.

7.21 *Sample replenishment - replace the missing product or variety with the currently most representative one by going through a process of re-sampling*. The extent to which a sample remains representative is highly dependent on the rules used for item replenishment when a particular variety or product disappears from the shelf of a particular outlet. Compared with the option of replacement with the most similar product, sample replenishment has the benefit of maintaining the up-to-dateness of the sample. If disappearing products are always replaced with similar products the sample will gradually become less relevant to market reality. Sample replenishment also increases the chances of the replacement being available on the shop shelf for pricing. The problem of a deteriorating sample increases with the rate of turnover in varieties and products and with the rate of product development.

Quality adjusting the price for differences in quality

7.22 When a product disappears or is replaced with a new version of a different quality or specification, then one of the following methods of introducing the price of the replacement is adopted:

- Direct comparison.
- Direct (explicit) quality adjustment.
- Implicit quality adjustment (imputation).

7.23 In all cases, a nominal price in the base month is needed for the new or replacement product - this nominal base price is used until the next rebasing.

7.24 The price collector should record the specifications (the price-determining characteristics) of the new variety so that Head Office can determine if the replacement is of similar quality to the original variety. The price collector should determine if the shop is likely to continue selling the replacement. If it is also expected to be discontinued in the near future, then a different variety should be selected - either another that is similar to the first, or the most popular variety within the product line. As will be seen, there are several different methods for both the explicit and the implicit types of quality adjustment, but there are some common themes in the methods of each of these two main types. Explicit methods estimate the impact on price of changes in characteristics or features of the product. Implicit methods estimate the impact on price indirectly by reference to price differences between different varieties.

Direct comparison

7.25 If the selected replacement product is regarded as comparable, then the observed price change is treated as a pure price change. But the price statistician should gather and examine all the available evidence, if possible taking advice from market experts where necessary, before coming to such a conclusion. Even in cases where a replacement product is believed to be of comparable quality, care should be taken, since experience suggests that most goods tend to undergo steady improvements, especially hi-tech and electrical goods.

Direct or explicit quality adjustment methods

7.26 In explicit methods, the monetary value of the quality difference is determined directly and then applied to a previous period's observed price for the "old" item. This will yield an estimate of what the replacement item would have cost in the previous period.

7.27 Assume that the statistical office was able to determine that, based on the differences in characteristics, the value of the quality difference between Brand C and Replacement 1 was $25 in period 1. The price statistician can add this amount to the price of Brand C in period 1 to obtain an

Table 7.2 Explicit quality adjustment

Variety	Price Index Period 1	Price in Period 1	Price in Period 2	Price Ratio 2/1	Price Index Period 2
Brand A	125.0	150	160	1.067	133.3
Brand B	150.0	225	250	1.111	166.7
Brand C	125.0	140	–		
Replacement 1		*(165)*	180	1.091	136.4
Elementary Aggregate Index (geometric mean)	132.83			1.0895	144.7

estimated price for replacement 1 of \$165 (\$140 + \$25) as shown in Table 7.2.

7.28 The price relative for Replacement 1 can be derived (\$180 / \$165 = \$1.091) and used to calculate the price relative for the aggregate index ([1.067 x 1.111 x 1.091]$^{1/3}$ = 1.0895). The period 2 indices for the elementary aggregate and for Replacement 1 are 144.7 (= 1.0895 x \$132.83) and 136.4 (=\$125.0 x 1.091), respectively.

7.29 There are a number of direct or explicit methods for determining the price associated with a change in quality. But quality adjustment is not an exact science, and different evaluations can yield different results. The point is that even if the evaluation methods used are somewhat imprecise in the measurement of the quality difference, it is important to make an adjustment. If quality differences are not removed, the price index will reflect quality change in addition to pure price change and is likely to have an upward bias because quality usually increases.

7.30 Figure 7.3 of the CPI Manual provides a flowchart of the decisions needed for making quality adjustments. This is reproduced as Appendix 7.1 here.

7.31 The most common ways of determining an explicit quality adjustment in practice are as follows:

- *Package Size Adjustment* where the value of a change in package size is assumed to be proportional to the relative change in the package size.
- *Expert judgement.* This is where the price collector determines the value either through direct knowledge or in consultation with personnel in the shop where the product is sold. Alternatively, statistical office staff, who may be knowledgeable about the product, can estimate a value. Reliance on an individual's knowledge concerning the products depends, however, on the individual obtaining sufficient market information and is also liable to subjectivity. The judgement needs to be properly informed.
- *Reference to the producer cost.* The production cost from the producer can be used in the case of an improvement to an existing product, although a judgement then needs to be made on whether to apply an adjustment factor. For example, the latter might consist of the normal retail mark-up to reflect wholesalers and retailers costs and profits. In the context of a cost-of-living index a downward adjustment may be appropriate to account for the fact that the new "standard" feature will not increase the utility to all purchasers, e.g. some may not welcome air conditioning in a car because of the extra running costs. Compilers of the Producer Price Index often attempt to gather information on production costs from manufacturers for quality adjustment purposes. However, producers may be unwilling to provide information on their marginal costs for reasons of confidentiality. There are a number of potential problems with using the producer cost method. In particular, it is not necessarily the case that the cost of production, with an adjustment factor along the lines describe above, gives a good indication of the selling price[18].
- *The former "option" price.* In the case where an optional feature has become standard, the former price charged for the optional feature can be used as the explicit quality adjustment

[18] In constructing a consumer price index, consumer valuations of products should be decisive and the cost of production is irrelevant in this context. In "equilibrium" situations, the cost of production (using a "normal" cost of capital in the producer's user cost formula) should give a close approximation to the selling price (and hence the consumer's valuation of the product). But it is in exactly disequilibrium situations, involving new products where R&D has to be amortised using monopolistic prices where new products and obsolescence of old products is likely to occur that the assumptions of equilibrium breakdown.

value but again, consideration will need to be given to whether a scaling-down factor should be applied – in this case possibly a downward adjustment to reflect the reduced production costs of making a feature "standard" and also, in the cost-of-living context, the argument, presented earlier, that the utility gain is less than the increase in price. Some of the concerns relating to using producers' costs (see previous bullet point) apply, the main difficulty being that it is likely that the market valuation of the options will have changed once they become "standard", indeed, it is often because of changing market circumstances that producers make former options "standard".

- *Hedonic regression.* Another way to obtain a value of the quality difference is to use hedonic regression to estimate the value of changes in a product's characteristics. See Chapter 7 of the CPI Manual and also Triplett's *Handbook on Hedonic Price Indexes.*[19] Hedonic methods require large databases with a wide range of product characteristics. Such databases are seldom available in statistical offices (though for some products scanner data from large stores may be a viable source in some countries) and can involve substantial development and maintenance costs. In addition, hedonic models need to be re-estimated periodically. Hedonic methods should be applied only where they add significantly to the statistical integrity of the index. This is most likely to be the case with hi-tech high turnover goods.

Implicit quality adjustment

7.32 If the replacement product is of a different quality or specification and no information is available to quantify the difference, then assumptions have to be made about what proportion of the price difference is accounted for by differences in quality. Implicit quality adjustment creates an imputed "quality-adjusted" price based on price changes from similar varieties of the product. The precise nature of the imputation depends on the index formula that is used. A common basic assumption underlying the most commonly used implicit quality adjustment methods is that the difference in quality between varieties or models simultaneously available in the market is equal to the difference in price between the models[20]. Thus when a product disappears from the shelf, an underlying assumption is made when imputing a price that a price differential continues to exist to reflect a difference in quality. Examples of the different methods of imputation available to the index compiler are given in the next section.

7.33 Most countries construct some form of a fixed-base price index. If price movements are estimated using long-term price relatives from the base period, then the base price may be adjusted proportionately for the estimated quality difference. If price movements are estimated using short-term relatives from the previous period, then an imputation adjustment can be implicitly made by estimating the missing variety's price in the current month from the average price change in its elementary aggregate. The price change of the omitted observation is equal to the change in its elementary aggregate. Thus, imputation can be applied to either the long-term or short-term price relative. Some examples of adjustments using short-term price relatives are presented in more detail in the next sections. Examples of adjustments using long-term price relatives are given in paragraphs 7.2.1 to 7.2.9.

Examples of implicit quality adjustment methods

7.34 Consider the case in which the Jevons index formula (the un-weighted geometric mean of the short-term price relatives) is used to estimate the price index for an elementary aggregate which, as is the usual case, has no explicit expenditure weights:

$$I_t = \prod_{i=1}^{n} \left(p_{i,t} / p_{i,t-1} \right)^{1/n} \times I_{t-1}$$

Where I_t is the current (Period t) elementary aggregate index, $p_{i,t}$ is the current price of variety i, $p_{i,t-1}$ is the price of variety i in the previous period (Period t-1), and n is the number of varieties for

[19] Jack Triplett, *Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products*, STI WORKING PAPER 2004/9, Statistical Analysis of Science, Technology and Industry; OECD Publications, 2 rue André-Pascal, 75775 Paris, Cedex 16, France. Available at http://www.oecd.org/dataoecd/37/31/33789552.pdf

[20] For the argument to be valid it has to be assumed that the consumers are rational in their thinking and well informed about available alternative choices. It also has to be assumed that the market is "in a state of equilibrium", i.e. in a state that would persist indefinitely if all given conditions remained unchanged. In practice these assumptions may be adequate or inadequate to varying degrees in different product areas. Equilibrium conditions may be disrupted by temporary imbalances between supply and demand, such as stock clearances, bad harvests or scarce, much-demanded new models

which prices are collected in both periods for the elementary aggregate.

7.35 This is the short-term formula that computes the current index by multiplying the previous index by the average short-term change.

7.36 The other approach used frequently is the geometric mean of the long-term price relatives, which uses a short-term price relative to impute the missing price for the quality comparison, and the base price is adjusted to include an estimate of the change in quality. This approach is discussed in detail in Appendix 7.2. The principles of implicit quality adjustment are the same whether short-term or long-term price relatives are used. The different approaches are discussed below using the short-term price relatives for illustrative purposes.

Overlap pricing

7.37 This method requires knowledge of the prices of the two varieties in the same time period - the overlap period. If the old and new varieties are available at the same time and the price collector either knows in advance that the old variety will disappear soon and selects and prices a replacement, or the outlet is able to accurately give the price of the replacement in a previous period when the old variety was priced, then the price difference between the two is taken to be the value of the quality difference. The rationale is that it cannot be price change - price change occurs only over time. The price index uses the old variety in the overlap period and the new variety in the next period and the price differential between the two varieties never affects the index. In this case, the market has determined the value of the quality adjustment.

7.38 In reality, overlap pricing can only be applied in a minority of cases. Prior warning of a product disappearing from the shelves is rarely given and obtaining a price relating to an earlier period can be difficult. In addition, it is important to ascertain whether the old variety is available only at clearance prices. This often occurs when only a few are available and the shops in which they are sold have deep discount prices in an effort to sell quickly the remaining stocks of the old variety. A careful evaluation must be made as to whether such discount prices adequately reflect the quality difference. Some commentators have also questioned the underlying assumption that all the price difference, whether relating to clearance or full price, is accounted by quality differences.

7.39 One effective use of the overlap method is in the updating of samples that contain too many obsolete items, a topic which is discussed in Chapter 8.

7.40 The example in Table 7.3 illustrates the use of the overlap procedure.

7.41 The sample for this elementary aggregate consists of three varieties. When the price collector visits the shop in period 2 to collect the price for Brand C, they find that it is permanently unavailable. The shop manager and the price collector determine that Replacement 1 with a price of $180 is the most similar variety to Brand C. Review of the differences between the varieties indicates that Replacement 1 has extra features and is not fully comparable in quality to Brand C. The shop manager was able to determine, however, that Replacement 1 was available during the last price collection period and its price was $160. The price change for Replacement 1 ($180/$160 = 1.125) can now be used to calculate the index this month. Using the geometric mean the price change for the elementary aggregate can be derived to be $(1.067 \times 1.111 \times 1.125)^{1/3} = 1.101$. Applying this to the previous index for the elementary aggregate yields its current period value of 146.2. The quality difference that has been excluded from the index is the price differential between Replacement 1 and Brand C ($160 – $140 = $20). If Replacement 1 had been compared directly to Brand C ($180 / $140 = 1.151), then the item index would have risen to 152.9, significantly

Table 7.3 Quality adjustment using the overlap method

Variety	Price Index Period 1	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	125.0	150	160	1.067	133.3
Brand B	150.0	225	250	1.111	166.7
Brand C	125.0	140	--		
Replacement 1	--	160	180	1.125	140.6
Elementary Aggregate Index (geometric Mean)	132.83			1.101	146.2

Table 7.4 Quality adjustment using overall mean imputation

Variety	Price Index Period 1	Price in Period 1	Price in Period 2	Price Relative	Price Index Period 2
Brand A	125.0	150	160	1.067	133.3
Brand B	150.0	225	250	1.111	166.7
Brand C	125.0	140	*(152.4)*	*1.089*	136.1
Replacement 1 (for Brand C)			180		
Elementary Aggregate Index	132.83			1.089	144.6

overstating price change. Alternatively, had the price statistician assumed the price of Brand C remained $140 (linked to show no change); its imputed index would be $140.6, a substantial understatement.

7.42 Note that if the long-term price relative formula is used to compute price indices, the base price must be adjusted by the ratio of the new variety's price to the old variety's price in the overlap period and the adjustment for quality change is equal to the ratio of their prices in the overlap period (see Appendix 7.2).

Overall mean imputation (sometimes referred to as the non-class mean or, in the context of the European Harmonised Index of Consumer Prices, the bridge overlap method)

7.43 Overall mean or non-class mean imputation (also referred to as "linking" or "splicing") imputes an overlap price for the old variety in the current period by reference to the price changes between the previous and current periods of similar items.

7.44 The latter are used to impute a price change for the old variety, which can then be used to obtain the imputed price. The ratio of the imputed price for the old variety and the price of the new variety in the current period is the estimated quality adjustment.

7.45 An estimate of the price of the missing variety can still be made even though the price of the replacement variety may not be known for the previous pricing period. The example in Table 7.4 illustrates how to make such an estimate and to implicitly adjust for quality differences using the overall mean price change for the elementary aggregate.

7.46 To derive the required price relative the price statistician can estimate the price of the original variety by multiplying the price of Brand C in the previous period by the average price change of the other varieties available this month. For the missing variety (Brand C), an imputed price relative between period 1 and period 2 is calculated using the geometric mean of the price changes (price relatives) of the two varieties (Brand A and Brand B) for which actual prices were collected.[21] This yields $(1.067 \times 1.111)^{1/2} = 1.089$. This is multiplied by Brand C's period-1 price of $140 to get an estimated (imputed) period-2 price of $152.4. The amount of the quality adjustment is the difference in period 2 between the price for Replacement 1 and this estimated price ($180 – $152.4 = $26.6). Note that this procedure provides an estimate for Brand C from matched pairs. Replacement 1's price will not be used until the next period (period 3). The price relative for the elementary aggregate is the geometric mean of the price relatives of the three varieties (i.e. including the price relative for the imputed variety) $(1.067 \times 1.111 \times 1.089)^{1/3} = 1.089$ as shown in Table 7.4. Applying the aggregate's price relative to its period-1 price index yields the period-2 index. (Note that the geometric mean of the varieties' price indices yields the same result- $(133.3 \times 166.7 \times 136.1)^{1/3} = \$144.6$)

7.47 The overall mean procedure assumes that the pure price change from the replaced item to the replacement item is the same as that for the composite of all other goods in the same group. It is used frequently because of its simplicity, but there can be an inherent bias built into the methodology, particularly when major model changes are occurring. The direction and extent of this bias is a matter for debate but depends on whether the true quality adjusted change in price is bigger or smaller than the measured price changes of the items used in the imputation. Major price changes can frequently occur at the time new varieties or models of a product are introduced. This is quite common, for example, with new vehicles, household appliances, electronic equipment, and clothing items. As the new varieties are introduced there may

[21] The same result is, of course, obtained using the price relative of the geometric average prices:
$(160 \times 250)^{1/2} / (150 \times 225)^{1/2} = 1.089$.

Table 7.5 Class mean imputation where one replacement is not comparable

Variety	Price Index Period 1	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	125.0	150	160	1.067	133.3
Brand B	150.0	225	250	1.111	166.7
Brand C	125.0	140	*(155.6)*	*1.111*	138.9
Replacement 1 (for Brand C)			180		
Elementary Aggregate Index (geometric mean)	132.83			1.096	145.6

still be a substantial supply of the old varieties, which are showing little price change or may actually be declining in price. In consequence, using the old varieties' price changes to impute the price changes for new ones will underestimate the true price change for the new varieties and cause a downward bias in the price index. The use of the overall mean imputation procedure, in which all observations in the elementary aggregate are used, is not recommended for such cases. It is also possible, and can be argued (but less convincingly) that the use of the overall mean leads to an upward bias because the price changes associated with models that are unchanged in quality will be further along the evolutionary cycle and therefore will be rising less rapidly An alternative imputation procedure, called "class mean" imputation, avoids some of the problems associated with bias.

Class mean imputation

7.48 Class mean imputation is similar in procedure to the overall mean imputation but uses only the price changes of "comparable" replacements to impute the overlap price, the replacements being limited to those that have exactly the same price-determining characteristics, or those items with replacements that have been declared comparable after review or have already been quality-adjusted through one of the "explicit" methods. For example, when the arrival of a new model of a particular make of motor vehicle forces price collectors to find replacements, some of the replacements will be of comparable quality, others can be made comparable with explicit quality adjustments, but the remaining ones will need imputed prices. Class mean imputation calculates imputed price relatives using only the prices of comparable and, where appropriate, explicitly quality-adjusted varieties or models. In general, it does not use the prices for the varieties or models that were not replaced, because these are likely to be different from those of new models. The prices of old models tend to fall as they become obsolete, while the new models (represented by the replacements) tend to have a higher price before falling. This may not be such a big issue in developing countries where new products appear in the retail market relatively late at a "mature" price. Using class-mean imputation adds complexity, but reduces two types of bias referred to earlier: bias from ignoring quality change altogether and treating all price movements as price change; bias from over over-adjusting for quality change by treating some pure price change as quality change.[22]

7.49 The previous examples assumed that there were no differences among the product varieties within the elementary aggregate. Now assume that Brand A is a variety that was available in both periods and that Brand B is a model that is new in period 2 and that was deemed comparable in quality to the previous model priced in period 1. The replacement for Brand C (Replacement 1), however, is deemed not comparable in quality to Brand C, so class mean imputation uses only Brand B's price change to impute a price for Brand C. It does not use Brand A's price change, because Brand A is an old variety and is therefore likely to have a price change which differs from new varieties such as Brand B. In this case the price relative is 1.111 and the imputed price, $155.6. See Table 7.5.

7.50 The amount of the implicit quality adjustment is the difference between the prices for Replacement 1 and Brand C ($180 – $155.6 = $24.4). In general, class mean imputation can be used with any targeted group of observations. It is often found that some varieties are available all year with little price change. They maintain constant levels of quality from period to period. At the same time, other varieties go through model change, where new models are introduced periodically throughout the year. Sellers normally increase the price when they

[22] Clothing, items usually require additional procedures to control substitutions depending on the season of the year, e.g., autumn/winter versus spring/summer clothing.

Table 7.6 Quality adjustment using matched models method

Variety	Price Index Period 1	Price in Period 1	Price in Period 2	Price Relative Period 1 to 2	Price Index Period 2	Price in Period 3	Price Relative Period 2 to 3	Price Index Period 3
Brand A	125.0	150	160	1.067	133.3	170	1.063	141.7
Brand B	150.0	225	250	1.111	166.7	265	1.060	176.7
Brand C	125.0	140	–	*(1.089)*	*(136.1)*	–	–	–
Replacement 1 (for Brand C)			180	–	136.1	200	1.111	151.2
Elementary Aggregate Index (geometric mean)	132.83			1.089	144.6		1.078	155.8

introduce new models, especially if they add new features that affect the quality of the products. In the case of the new models, it is better to impute the missing price using only the price change of those observations experiencing model changeover and exclude those that are not.

Matched models

7.51 This is also referred to as monthly chaining and replenishment. The matched model method compares only "like-to-like" observations that are of the exact same model or variety with the exact same quality from period to period. Thus, when a variety or model disappears and the price collector picks a replacement, the statistical office makes no attempt to adjust for any quality differences. The price index in the current period is compiled using only the matched observations that are available in both periods. The aggregate relative price change between any two adjacent periods is measured as the aggregate relative price change for the set of all models that are available in both those periods as seen in Table 7.6.

7.52 The example has been expanded to cover an additional period (Period 3) in order to demonstrate how the price index is calculated in each period. In period 2 matched observations are available for Brands A and B only. Although a price is collected for Replacement 1, it is not used in the calculation this period. The aggregate index is based on the average price change in the two matched varieties. The aggregate price relative is the geometric mean of the price relatives for Brands A and B, $(1.067 \times 1.111)^{1/2}$ = 1.089. This short-term price relative is then applied to the price index for period 1 to derive the period-2 price index (1.089 x 132.83 = 144.6).

7.53 In period 3, the period-2 variety index for Brand C must be estimated and assigned t Replacement 1. The period 2 aggregate price relative (1.089) is applied to the period-1 index for Brand C (125.0) to estimate Brand C's price index (1.089 x 125.0 = 136.1) for period 2. Now, when the period-3 price is available for Replacement 1, a price relative can be calculated ($200/$180 = 1.111) The price relative for Replacement 1 is applied to period-2 price index for Brand C to get the period-3 price index for Brand C (1.111 x 136.1 = 151.2)

7.54 In period 3, there are three matched models available and their price relatives are used to calculate the aggregate price relative ($[1.063 \times 1.060 \times 1.111]^{1/3}$ = 1.078), which is multiplied by the period-2 price index to obtain the period-3 price index (1.078 x 144.6 = 155.8). Note that the same result occurs if we take the geometric mean of the variety level price indices ($[141.7 \times 176.7 \times 151.2]^{1/3}$ = 155.8). Note that rounding affects these calculation results.

7.55 The matched model method should give *exactly* the same results to the overall mean method for quality adjustment, regardless of whether Jevons, Carli or Dutot indices are computed at the elementary level. It is often used in situations such as in home electronics (including computers), household appliances, and mobile phones where new models are frequently introduced.

Summary

7.56 In the above examples, the price change for the elementary aggregate index in period 2 has varied between 8.9% and 10.1%, indicating that different methods yield different results. The quality-adjusted price changes are much lower, however, than if no action had been taken and Replacement 1's price ($180) had been compared to Brand C's price ($140). This would give a price relative of 1.286 (=$180 /$140) at the variety level

and resulted in a change at the elementary aggregate level of 15.1% ($[1.067 \times 1.111 \times 1.286]^{1/3} = 1.151$). The quality adjustment methods have, therefore, removed the price statistician's best estimate of the monetary value of the quality change (given the information available) from the overall price difference, so that the price index measures only pure price change. Adjustment for quality change is an art for price index practitioners but ignoring quality change can result in a substantial overstatement of price change, for instance when price increases due to quality improvements associated with new products are included in the price index. On the other hand, attempting to correct for this problem by the use of a link-to-show-no-price-change method when replacement varieties are introduced can result in over-adjustment for quality change (with some pure price change being counted as quality change and being excluded from the price indices) and thus an understatement of price change. The bias can go either way.

Replacing products during periods of supply shortages

7.57 Most statistical offices have rules regarding the length of time that they will estimate a price for a missing product. Usually this is between 2 and 6 collection periods, after which time they assume the product is permanently missing. This is a good rule of thumb to follow. During extended periods of supply shortages, however, it can be problematic. The shortage may result in long queues of buyers trying to purchase the products and, possibly, a parallel (black) market where the prices are considerably higher. The prices recorded in the CPI should ideally be those actually paid by consumers, so prices should reflect those both in regular and, where practical, in parallel markets. The fact that prices for products experiencing a shortage may rise rapidly under these circumstances is not a reason to exclude them and their price changes from the CPI. In practice many CPIs follow the prices in a sample of shops, making it hard to add prices from new (and perhaps less legitimate) sources.

7.58 Products may not be available in specific markets or in certain regions of the country, and it may not be known when or if the missing products will return to these markets. As long as the product is available in some markets, the statistical office should consider imputing the price of the missing product based on the price trend in a neighbouring area or based on the change in the national average price calculated from those areas where the product is available. When the product returns, prices may again be collected in those areas. Alternatively, in those areas where it is not available, the product, along with its weight, could be dropped from the sample, so that it does not enter into the index calculation. The disadvantage of this method is that the product cannot be added back to the sample easily once it is dropped. It will have to be treated as a new product and added using the methods discussed in Chapter 8 of this Handbook. Thus, for practical reasons, the statistical office should be very cautious about dropping products from the sample if there is a likelihood that they might return.

7.59 The price of a missing product should be imputed from period to period using the price change of the class, subgroup, or group in which the product belongs (that is, the price change at the next highest level in the aggregation structure). The CPI Manual especially warns against using the carry-forward technique (repeating the last available price) under these circumstances (see paragraphs 7.71 and 9.50 of the Manual). Repeating the last available price assumes that there has been no price change for the product, when, in fact, it is known that prices are changing where the product is available.

7.60 In cases of severe supply shortages, a key product may be missing in all areas of the country. In such circumstances, the statistical office will need to assess whether the product is likely to return sometime in the future. If it appears likely to return, then the standard waiting period for selecting a substitute could be suspended, and its price imputed from other prices for many periods. If it appears that the product will never return, then it should be treated as permanently unavailable and a substitute product selected for price collection. If there is no substitute product available, then the product and its weight will need to be dropped from the index calculation. If it has permanently gone and no reasonable substitute is available, then the product should have no part in the calculation of the CPI. It is wise, however, to maintain the sample size by replacing the item with another relevant product in the same category.

7.61 Data from recent household budget surveys or retail sales information could be used for identifying additional products if data are collected in sufficient detail. However, the statistical office should be careful about using weights from these sources to update the weights in the CPI because the weights should reflect spending patterns in a normal or stable period (see the CPI Manual, paragraph 4.44) and avoid unusual periods such as those with shortages.

7.62 A major concern in these situations is that the sample size may diminish significantly, with a

corresponding decrease in the precision of the index. Very few countries are able to produce estimates of variance and bias associated with a declining sample, but a simple rule related to sample size may be helpful to determine which index series should continue to be published under these circumstances. A number of statistical offices use a 50 percent rule whereby they discontinue publication of CPI series in which the sample size falls below 50 percent of the target sample. Thus, for each published index series at the class, group, or division level where the sample falls below this threshold, the statistical office discontinues publication until the sample size can be increased. When published series are suppressed, the statistical office should notify users that the reason for not publishing the series is due to diminishing availability of representative products and sample of prices.

Appendix 7.1

Flowchart for making decisions on quality change

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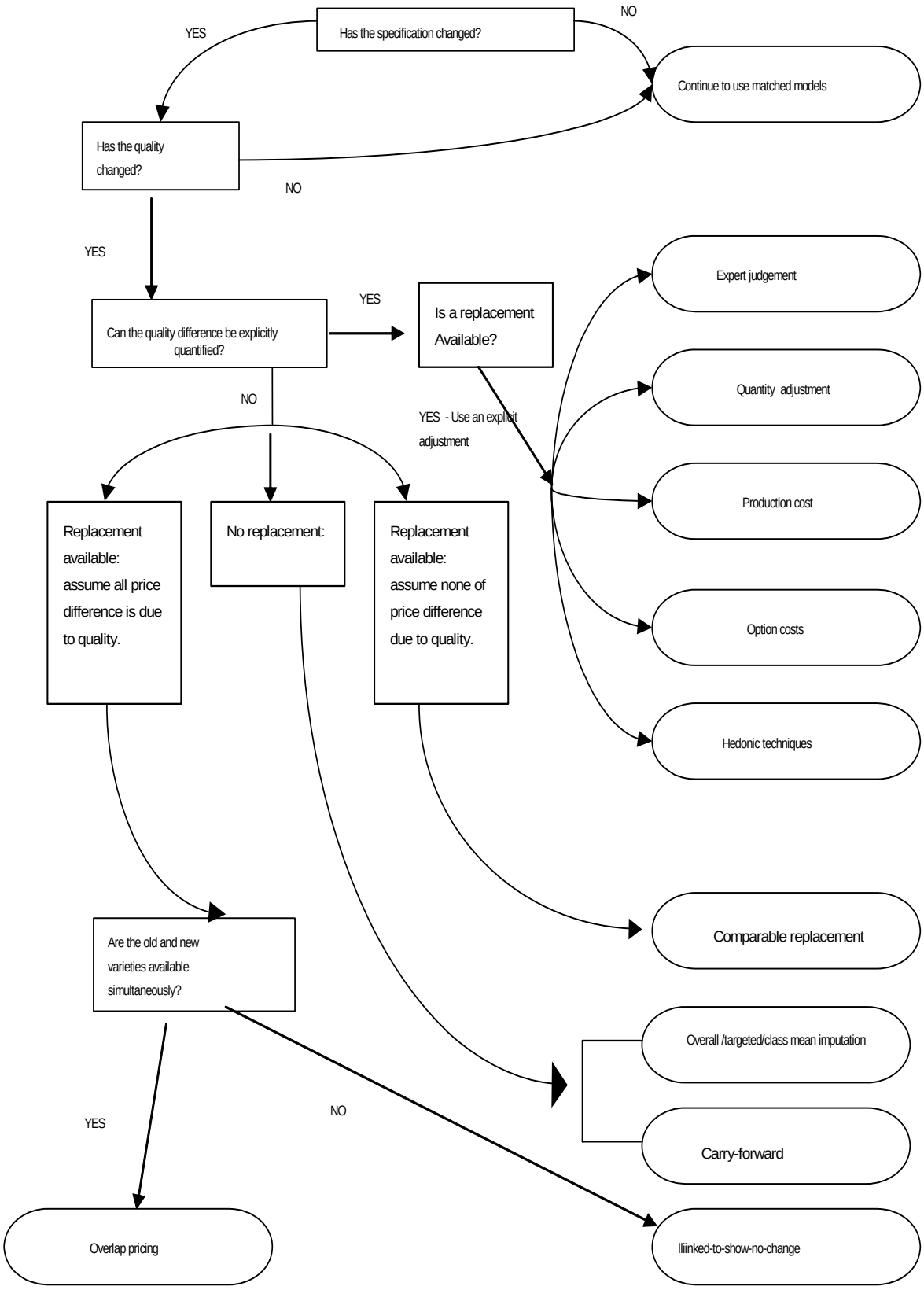


Appendix 7.2 Adjustments Using Long-term Price Relatives

7.2.1 The discussion and examples in the main body of the chapter assume that the statistical office is using the short-term price relative index formula to calculate the elementary aggregate. Many countries use the long-term price relative formula:

$$I_t = \prod_{i=1}^{n} \left(p_{i,t} / p_{i,0} \right)^{1/n} \times 100$$

Where I_t is the current elementary aggregate index, $p_{i,t}$ is the current (period t) price of variety i, and $p_{i,o}$ is the price of variety i in the base period (period o).

7.2.2 Since there typically are no expenditure weights within elementary aggregates, each observation has the same weight, 1/*n*, where *n* is the number of varieties for which prices are collected within the elementary aggregate. The long-term formula is an average of long-term (current period to base period) price relatives.

7.2.3 Compare this formula to the short-term formula that uses the average of short-term (current to previous period) price relatives. Quality adjustment using the short-term relative is easier because the price statistician is estimating the value of quality difference between two varieties observed in two adjacent periods - the adjustment is made either to the current or previous period to get the correct short-term price relative. The long-term (current to base period) formula, in which the price relative of each observation is an estimate of its change in price from its price in the base or reference period, requires that quality be kept constant over this long period. This is more difficult to do. It requires the assumption that the relative quality difference is the same in the base period as at a later - often much later - period. Quality adjustment with the long-term relative formula calls for the statistical office to calculate a quality adjustment factor equal to the ratio of the price (either collected or imputed) of the new-quality variety to that of the price of the old-quality variety in the same time period and then apply the factor to the base price so that the base price will represent the new quality. The long-term price relative can then be calculated using the price of the new quality variety to the quality-adjusted base price.

7.2.4 In the previous examples, the period-1 price for Brand C is $140 and the price index in period 1 is 125.0, so that the base price must have been $112 ([$140 / 125] x 100). In the *explicit adjustment* example the price of Replacement 1 with the new quality is $165 in period 1, which was derived by valuing the quality difference as $25 in period 1. We compare the period 1 price of Replacement 1, which has the new quality, to Brand C with the old quality ($140). (Again, this comparison is made for the first period in which the prices of brands with the two qualities are available.) The QA factor is 1.1786 ($165 / $140), which is then applied to the Brand C base price ($112) to derive the new base price of $132. This base price is used in the calculation of the period-2 long-term price relative for Replacement 1. Table 7.2.1 demonstrates the compilation of the elementary aggregate index using the long-term relative formula.

7.2.5 In the *overlap* example – see Table 7.1.2 - Replacement 1's period-1 price ($160), which includes the cost of the new quality, is the price which is compared with the price including the cost of the old quality, which is Brand C's period-1 price ($140). The quality adjustment factor of 1.14286 (= $160 / $140) is applied to the old quality base price ($112) to derive the new base price of $128, which is used in the calculation of the period-2 long-term price relative for Replacement 1. Table 7.2.2 demonstrates the compilation of the elementary aggregate index using the long-term relative formula.

7.2.6 In the *overall mean* example period 2 is used for the quality comparison: Replacement 1's period-2 price ($180) includes the cost of the new quality and Brand C's Period-2 estimated price ($152.4) includes the cost of the old quality. (Note again that the comparison is made using the same time period; it would not be valid to compare Replacement 1's price in period 2 to Brand C's price in period 1 because the price of Brand C, if it were available, would most likely have changed similarly to the other prices within the elementary aggregate.) The quality adjustment factor of 1.1811 (=$180 / $152.4) is applied to the old base price ($112) to estimate the new base price ($132.3). Table 7.2.3 demonstrates the compilation of the elementary aggregate index using the long-term relative formula.

7.2.7 In the *class mean* example period 2 is also used for the quality comparison; again Replacement 1's period-2 price ($180) includes the cost of the new quality and Brand C's period-2 estimated price ($155.6) includes the old quality cost. The quality adjustment factor of 1.1576 ($180 / $155.6) is applied to the old base price ($112) to estimate the new base price ($129.6). Table 7.2.4 demonstrates the compilation of the elementary

aggregate index using the long-term relative formula.

7.2.8 The calculations for the *matched model* example are similar to those for the overall mean method. Period 2 is also used for the quality comparison because it is the first period that allows one to be done. Replacement 1's period-2 price ($180) includes the cost of the new quality and the price of Brand C in period 2 is estimated by using the geometric mean of the short-term price relatives of Brands A and B (*1.089*). The price relative is applied to Brand C's period-1 price ($140) to derive an estimated price ($152.4) for Brand C that has the old quality. (Note again that the comparison is made using the same time-period - period 2.) The quality adjustment factor is 1.1811 (=$180 / $152.4), which is applied to the old base price ($112) to estimate the new base price ($132.3). Table 7.2.5 demonstrates the compilation of the elementary aggregate index after quality adjustment, using the long-term relative formula.

Table 7.2.1 Calculation of quality-adjusted EA index using *explicit adjustment* method

Variety	Base Price	QA Factor	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	120	–	150	160	1.333	133.3
Brand B	150	–	225	250	1.667	166.7
Brand C	112	–	140	–		
Replacement 1	*(132)*	1.1786	*(165)*	180	1.364	136.4
Elementary Aggregate Index (geometric mean)	100.0				1.447	144.7

Table 7.2.2 Calculation of quality-adjusted EA index using *overlap* method

Variety	Base Price	QA Factor	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	120	–	150	160	1.333	133.3
Brand B	150	–	225	250	1.667	166.7
Brand C	112	–	140	–		
Replacement 1	*(128)*	1.14286	160	180	1.406	140.6
Elementary Aggregate Index (geometric mean)	100.0				1.462	146.2

7.2.3 Calculation of quality-adjusted EA index using *overall mean* method

Variety	Base Price	QA Factor	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	120	–	150	160	1.333	133.3
Brand B	150	–	225	250	1.667	166.7
Brand C	112	–	140	*(152.4)*		
Replacement 1	*(132.3)*	1.1810	–	180	1.361	136.1
Elementary Aggregate Index (geometric mean)	100.0				1.446	144.6

Table 7.2.4 Calculation of quality-adjusted EA index using *class mean* method

Variety	Base Price	QA Factor	Price in Period 1	Price in Period 2	Price Relative 2/1	Price Index Period 2
Brand A	120	–	150	160	1.333	133.3
Brand B	150	–	225	250	1.667	166.7
Brand C	112	–	140	*(155.6)*		
Replacement 1	*(129.6)*	1.1571	–	180	1.389	138.9
Elementary Aggregate Index (geometric mean)	100.0				1.456	145.6

Table 7.2.5 Calculation of quality-adjusted EA index using *matched model* method

Variety	Base Price	QA Factor	Price in Period 1	Price in Period 2	Short-term Price Relative	Long-Term Price Relative	Price in Period 3	Long-term Price Relative
Brand A	120		150	160	1.067	1.333	170	1.417
Brand B	150		225	250	1.111	1.667	265	1.767
Brand C	112	1.1810	140	(*152.4*)	*(1.089)*	–	–	–
Replacement 1	(*132.3*)			180	–	1.361	200	1.512
Elementary Aggregate Index (geometric mean)	100.0				1.089	1.446		1.558

CHAPTER 8

New Products

Introduction

8.1 The complication of new products appearing in the market place is covered in Chapter 8 of the CPI Manual, paragraphs 8.32–8.58. It provides a practical definition of a new product to distinguish it from an existing product whose features have changed and provides guidance on the detection of new products, the timing of their introduction and methods for their initial incorporation into the CPI.

8.2 Paragraph 28 of the ILO Resolution advises that "completely new types of goods and services should normally be considered for inclusion (in the index) only during one of the periodic review and re-weighting exercises". It then goes on to offer the advice that a new model or variety of an existing product that can be fitted within an existing elementary aggregate should be included "at the time it is assessed as having a significant and sustainable market share".

8.3 This chapter of the Handbook addresses some of the practical issues of planning for the introduction of new products, the timing of introduction and the methods of incorporating them into the CPI. It also deals with the special issue of the incorporation into an index of services previously provided free.

Definition of New Products

8.4 An entirely new product, in contrast to a new product variety which is essentially a replacement of a previously popular product, represents a good or service that:

- Was not included and could not be included in the price index during the initial selection of the current market basket and which is now available for possible inclusion in the index.
- Cannot be easily linked to the service flow or production technology of existing goods and services. That is, it represents a distinct departure from previously available products in so far as it is a step change in terms of technology or utility to the customer.
- Has a recognisable and generally accepted new benefit to consumers as a result of becoming available.

8.5 The last two bullet points help to distinguish an entirely new product – referred to as a *revolutionary* product - from an existing product whose features and, in consequence, "quality" have changed – an *evolutionary* product. A revolutionary product is an entirely new good or service that is not closely tied to a previously available product. A revolutionary product tends to be a good or service that is expected to satisfy some need in a new way and is unlikely to fit neatly into an existing CPI item category. For example, a mobile telephone, whilst in one way an extension of an existing flow of service (telecommunication), has a dimension of service which is new (it provides the opportunity to make "mobile" calls away from a fixed telephone) and is a distinct product from existing land-line telephone services (it is a step change in technology). It is therefore an example of a revolutionary product. Examples of evolutionary products would be new models of household appliances such as refrigerators and washing machines where improvements in quality are introduced from time to time. Evolutionary products can also be newly added brands of currently available products such as a new type of canned fish or electronic appliance which differs from those currently available. For example, a current brand of canned fish may consist of certain types of fish (mackerel, salmon, or tuna) and then a new variety for one of the canned fish is introduced which is packed in water rather than oil.

8.6 The focus of this chapter is on keeping the basket of goods and services that are priced up-to-date and relevant. It covers both truly and completely new products, i.e. those which are *revolutionary,* as well as *evolutionary* new products and also goods or services previously provided free and thus previously excluded from the CPI. It does not deal directly with substitution and quality change when a good or service unexpectedly disappears. This is the subject of Chapter 7.

Planning for the introduction of new products

8.7 There are three sets of circumstances in which new products and services are included in the CPI:

- As *replacements* for products which no longer exist. This is normally associated with *evolutionary* products. Producers often discontinue old versions of their products and introduce new versions that are quite similar, but may be of a different quality at a different price. Note that "quality change" includes changes in technical specifications as well as more clearly visible outward changes in design. This can happen frequently and is usually unplanned for in a CPI although not necessarily unexpected. It is more often than not associated with forced replacements when collectors go to price a product only to find that it is no longer sold. In the CPI, collection procedures usually instruct price collectors to replace the old versions (models) with:
  - The most similar model. For example, when the old model of washing machine is discontinued, the price collector is instructed to replace it with another model which has similar (though probably not identical) specifications and to record any changes in characteristics (specifications) to aid the evaluation of potential quality differences.
  - Alternatively, replacements can be products that are currently the most popular with consumers. This represents a deliberate attempt to refresh the CPI basket when a replacement has to be made. For example, the current varieties of canned fish may include tuna. Producers may have introduced a new variety that contains tuna packed in water rather than oil, and consumers are now shifting their buying patterns to purchase more of the new variety. There is no external factor forcing the consumer to change to the new product.

  In some instances, when a model ceases to be produced the manufacturer will indicate which model is the replacement one and the CPI collection procedures instruct the price collector to start collecting the price of this replacement. This also normally contributes to the replenishment of the sample, as manufacturers usually introduce more up-to-date features into new models but how representative the new model will become, as measured by its popularity will only be determined over time.

  Further discussion of the methods for introducing into the CPI basket replacements for products which no longer exist and disappear from the shop shelves is presented in Chapter 7.

- As a *supplement* to the sample by adding a new variety or making a targeted replacement to drop an old variety and add a new one. This represents a more proactive approach to product substitution. Again, it is normally associated with *evolutionary* products. The CPI collection procedures instruct price collectors to replace the old, less popular variety of canned tuna fish in oil, with the new, more frequently bought, tuna packed in water even though the former remains available. This is different from the standard reactive approach of replacing the old disappearing variety with the new one because the old variety still exists and may not be discontinued although may be increasingly difficult to find. The new variety is supplementary to the old variety and begins to gain market share while the old variety declines in market share. This more proactive approach requires the price statistician to keep an eye open on the market for the entry of new varieties and to get a sense of their popularity with consumers, for example by noticing the changing proportions of shelf space occupied by the different varieties or by talking to the shopkeeper. Head Office can also help by gathering sales information from other sources.

- As a *planned introduction of a revolutionary product* which consumers begin to buy so that the product has an increasing share of the market. The appearance of revolutionary products in the market place and consumer reaction to them, as measured by sales, are less predictable than for evolutionary products. Revolutionary products also tend to have different price trends from other products in the sample and can therefore exert an influence on the CPI disproportionate to actual sales. For these reasons revolutionary products are important, represent a significant challenge and warrant special attention, requiring the price statistician to be particularly attentive and proactive.

  The above circumstances can be managed either in a planned way, as part of a regular process of updating the CPI basket, including chain linking (the latter is covered in Chapter 10) or in an ad-hoc way when the need arises or the circumstances warrant action to be taken.

Timing of the introduction of new products

8.8 The timing of introduction of new products can vary by the type of product, and may be dictated by the method of incorporation into the index. For revolutionary products it can be particularly critical to the accuracy of the index as there is a greater potential for introducing bias if these products are ignored. This is less likely to be the case for evolutionary goods. Again, it is useful to make the distinction between revolutionary and evolutionary goods:

- Evolutionary products are often introduced when one evolutionary model is discontinued and a new one appears. This process of forced replacements and the corresponding procedures are largely covered in Chapter 7. Timing is generally less critical than the choice of strategy which is adopted for identifying suitable replacements. Note that evolutionary products can co-exist with their predecessors on a long-term basis in the form of supplementary products. For example, where the new variety of canned fish, tuna packed in water, does not entirely replace tuna packed in oil, the latter being preferred by some customers and continuing to have significant sales but perhaps not being available in all shops. In this case both varieties will continue to be priced in the CPI basket and the number of forced replacements will be limited.

  Chapter 7 presents two alternative strategies that can be adopted when choosing a forced replacement - replacing with the most similar product or replacing the missing product or variety with the currently most representative one. The latter is one which is more likely to maintain the relevance of the sample by going through a process of re-sampling and identifying an appropriate replacement product. In order to make a properly judged decision on which strategy to follow and also to inform the choice of replacement product and timing of introduction, the statistical office needs to be aware of current consumer market trends, including what new products are becoming popular and what supplementary products are being introduced. Also important is the monitoring of product turnover, which can be an indication of the rate of product development associated with evolutionary products, and can vary between different categories of products. This information can be obtained from information gathered by price collectors and their supervisors, commodity experts in the statistical office (for instance, working on the CPI or the producer price index) or from trade journals or consumer reports.

  Evolutionary products should be included in the sample as soon as it is clear that consumers are shifting to these new products from the old versions. A frequent updating of the basket reduces the need for the ad-hoc introduction of evolutionary products.

- Revolutionary products are very different. These usually first appear in the market place at a high initial price to cover development costs and to exploit the novelty value to the consumer. The prices generally start to decline as they become more established and competing varieties enter the market resulting in increased supply. The timing of introduction into the CPI basket is a critical issue – if introduced too late it will not only reduce the representativity of the CPI basket but could also give too much weight to any price decline associated with obsolescence of the product it is replacing when the latter nears the end of its life cycle but is still in the CPI basket. It is clear that for revolutionary products the timing of their introduction into the CPI is an important issue. In practice, often they are not introduced until they can be included in a new basket at the time of a CPI revision. This can lead to out-of-date and unrepresentative baskets if the revisions are carried out infrequently or with a long time-lag, for instance as a result of delays in processing household budget survey data. But the price statistician is also confronted with uncertainty: it is not always clear how the retail market will react in the longer-term to the introduction of a revolutionary product – some will be highly successful, achieving significant sales volumes and market stability in a relatively short time, while others may achieve high sales at an early stage which are not maintained.

8.9 Methods of introduction which overcome the problem of lack of timeliness include sample supplementation, targeted replacement procedures and re-initiating (or rotating) the sample for the elementary aggregate or COICOP class. These methods are discussed in the next section and, sample re-initiation apart, are generally applicable to evolutionary products. For revolutionary products, a new elementary aggregate must often be created. Frequent updating of the CPI basket reduces the potential problems and the introduction of revolutionary new products at the time of a basket update has a number of operational advantages:

namely, the old weights do not need to be re-scaled when a new product class is introduced when an old basket is still being used which does not include the new product class. This re-scaling of weights is somewhat arbitrary (in reality it is not known exactly which other expenditures are being reduced relatively as the new product is purchased) and may lead to credibility issues.

Methods of incorporating new products into the index

Evolutionary products

8.10 Statistical offices have several approaches available to them to include evolutionary products. This section presents four approaches that are used by countries in an effort to bring new products into the CPI sample in a timely fashion, so that they are not overlooked or specifically excluded. For practical purposes and as a general principle, the statistical office should plan to introduce new products only once each year, perhaps at the beginning of the year at the time of a planned CPI basket update, although new products can be incorporated at any time in the year particularly if a monthly chained index method is used. An update of a CPI basket can, of course, be undertaken at any time, not only when new weights are introduced as part of a CPI rebasing.

8.11 The approaches shown below use the short-term relative method for compiling the index.

Sample supplementation

8.12 One approach to bringing in evolutionary product varieties is to add them within the existing elementary aggregate in which they appear (or belong). This is referred to as sample supplementation. For instance, take the case where a new canned fish, tuna packed in water, has been recently introduced to the retail market and has significant popularity in the shops. This new variety can be added to the existing sample in the elementary aggregate for canned fish as shown in Table 8.1.

8.13 Period 1 displays the sample currently used. The statistical office then decides to add the supplemental variety (tuna in water) in period 2. But prices for two periods are required before there is a matched pair. The period 2 elementary aggregate index (140.6) is computed using the geometric mean of short-term price relatives for the original 5 varieties (1.0307) multiplied by the previous period elementary aggregate index (136.4). In period 3 the new variety's price is available in both periods and the elementary aggregate index (143.3) is calculated by taking the geometric mean of short-term price relatives for the 6 available varieties (1.0190) multiplied by the period 2 price index (140.6). To estimate the period 2 variety level index for "tuna in water", we assign it the same value as the elementary aggregate index (140.6). This implicitly assumes that the price trend for the new variety from the base period is the same as that for all the other varieties within the elementary aggregate. If the long-term price relative method is used to calculate the elementary aggregate index, then the base price for tuna in water is estimated by dividing the first price of the new variety (60.00) by the long-term price change (1.406) to get a base price of

Table 8.1 Example of sample supplementation

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index
Canned mackerel (in oil)	125.0	50.00	51.00	1.0200	127.5	51.00	1.0000	127.5
Canned anchovies (in oil)	133.3	45.00	47.00	1.0444	139.3	48.00	1.0213	142.2
Canned tuna (in oil)	150.0	50.00	52.00	1.0400	156.0	52.00	1.0000	156.0
Canned salmon (in oil)	145.5	55.00	55.00	1.0000	145.5	57.00	1.0364	150.8
Canned herring (in oil)	130.0	40.00	42.00	1.0500	136.5	43.00	1.0238	139.8
Canned tuna (in water)	--	--	60.00		*140.6*	62.00	1.0333	145.3
Elementary Aggregate Index	136.4			1.0307	140.6		1.0190	143.3

42.66. The aggregate index is calculated as the geometric mean of the variety indices.

Targeted replacements

8.14 Supplementary varieties of an evolutionary product, or replacements for old and less representative varieties, can also be introduced by replacing an existing variety that has less importance and a declining market share with a new variety. Assume that tuna packed in oil has lost significant popularity among consumers and tuna packed in water has recently been introduced and is gaining significant popularity. Using the method of targeted replacement, the old variety of canned tuna is dropped and the new variety added. The method is shown in Table 8.2.

8.15 The period 2 elementary aggregate index (140.6) is computed using the geometric mean of short-term price relatives for the original 5 varieties (1.0307) multiplied by the previous period elementary aggregate index (136.4). In period 3 the new variety's price is available in both periods and the tuna in oil variety is dropped. The elementary aggregate index (143.9) is calculated by taking the geometric mean of short-term price relatives for the 5 available varieties (1.0229) multiplied by the period 2 price index (140.6). The new variety (tuna in water) is replacing the old, so the variety level index "tuna in water" remains at 156.0 (under the assumption that the price trend for the new variety would have been the same as the old).

Sample rotation (re-initiation)

8.16 In COICOP classes where new products are continuously appearing and old ones disappearing, the sample of products can quickly become outdated and be unrepresentative of what consumers are purchasing. The existing sample within a class may cover a broad and representative range of items that were available in the market during the base period but is not representative of all the varieties currently purchased. In such a case, the sample of varieties within each elementary aggregate can be totally re-sampled to reflect current spending patterns. This is referred to as sample rotation or re-initiation and an example is given in Table 8.3. It is used for the introduction of evolutionary products, but can also be used for revolutionary products when they fall within the scope of an existing elementary aggregate. Sample rotation is also the method associated with the regular process of reviewing and updating the CPI basket, including chain linking.

8.17 The sample rotation or re-initiation process uses an overlap approach. The old and new sample prices are collected in an overlapping period (period 2). The old sample is used to calculate the period 2 price index while the new sample is used in period 3. The change in prices of the new sample in period 3 is used to estimate the elementary aggregate level indices in period 3. For example, in Table 8.3 the price relative for the new sample of televisions in period 3 (0.9917) is applied to the elementary index for period 2 (104.1) to derive the elementary price index for period 3 (103.2).

8.18 The variety level indices in period 2 are not available for the new sample so the elementary aggregate index can be used as their starting point. For example, the period 2 price index for each of the new television varieties is set at the value of the period 2 elementary aggregate index (104.1). The

Table 8.2 Example of targeted replacements

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index
Canned mackerel (in oil)	125.0	50.00	51.00	1.0200	127.5	51.00	1.0000	127.5
Canned anchovies (in oil)	133.3	45.00	47.00	1.0444	139.3	48.00	1.0213	142.2
Canned tuna (in oil)	150.0	50.00	52.00	1.0400	156.0	--	--	--
Canned salmon (in oil)	145.5	55.00	55.00	1.0000	145.5	57.00	1.0364	150.8
Canned herring (in oil)	130.0	40.00	42.00	1.0500	136.5	43.00	1.0238	139.8
Canned tuna (in water)	--	--	60.00		*156.0*	62.00	1.0333	161.2
Elementary Aggregate Index	136.4			1.0307	140.6		1.0229	143.9

underlying assumption is that all the new varieties have experienced, on average, the same price movement as that for the elementary index. A base price for each new variety is estimated by deflating the period 2 price for each variety by the elementary aggregate index in period 2 (104.1, in other words a 4.1% average price rise for these varieties is applied from the base period). For example, the Sony 25" TV base price is estimated as 600 / 104.1 x 100 = 576.64. This base price is then used to calculate the variety level index in future periods. Note that the elementary level indices are calculated using the simple geometric means of price relatives.

8.19 The higher level index at the class level and above is compiled using a base-weighted arithmetic mean of the elementary indices. The weights for each elementary aggregate index appear in the last column of Table 8.3 and are used to weight the price index for each period to derive the class index (the last line in Table 8.3). For example, the period 3 class index is calculated by multiplying the elementary index by its corresponding weight and summing them to get the class index ([95.8 x 0.3] + [103.2 x 0.5] + [89.4 x 0.2] = 98.2).

Revolutionary products

Adding a new elementary aggregate

8.20 In the previous example, the sample of products was outdated and new varieties were selected within existing elementary aggregates. It will occasionally happen that new revolutionary products arise that are not covered within the scope of existing elementary aggregates but do fall within the more widely-defined COICOP classes. Adding a new elementary aggregate and re-distributing the weight for the COICOP class to all the elementary aggregates (or items) now included, is a way of including such products. For example, assume that currently telephones have a weight of 60% and fax machines 40%, respectively, within class 08.2.0 (telephone and fax equipment) and that the latest information from importers of telephonic equipment indicates telephones to households (i.e. where sales to businesses have been identified and excluded) now have a market share of 20%, fax machines 10%, and mobile phones 70%. The statistical office can use this information to introduce a new elementary aggregate for mobile phones. The weights at the class levels, including class 08.2.0, remain fixed for aggregating to group and division level indices while the relative weighting of the elementary aggregates within the class level are allowed to change as new aggregates are added. Thus, there is a two-tier aggregation system in which the weights at the class level remain fixed at the base period level and the weights within the classes at the elementary aggregate level are changed when new elementary items are added whilst being constrained to add to the unchanged class weight.

8.21 An overlap approach similar to sample rotation can be used where a new sample is selected and an elementary aggregate is added. Prices are collected for both the old and new sample in the same period and the old sample is used for compiling the current period index (period 2) and the new sample for the next period (period 3). This is illustrated in Table 8.4.

8.22 For each of the two elementary aggregates in period 1 a new variety to price in period 2 is selected together with a sample of mobile phones for the new revolutionary item. In period 2 the old sample is used to calculate the elementary aggregate indices and to compile the class level index. Thus, the indices for telephones and fax machines are aggregated using the old weights for the elementary indices to derive the period 2 class index ([101.5 x 0.6] + [94.3 x 0.4] = 98.6).

8.23 In period 3 the elementary and class level indices are compiled using the new sample of products and varieties along with the new set of weights for each component. The telephone index in period 3 (99.6) is calculated by using the geometric mean price relative for the three new varieties (0.9811) multiplied by the period 2 price index for telephones (101.5). The same calculation is used to derive the, period 3, elementary index for fax machines (0.9967 x 94.3 = 94.0).

8.24 The new elementary index for mobile phones has no period 2 index to use so the period 2 class level index (98.6) is used as the mobile phone index, on the assumption that the elementary index for mobile phones would have changed by the same percentage, on average, as the other products within the class. Note that this value is also used as the starting index for each of the variety indices within mobile phones. The period 3 mobile phones elementary index is calculated as 98.0 by using the elementary level price relative (0.9933) multiplied by 98.6.

8.25 The aggregate index is calculated as the geometric mean of the variety indexes.

8.26 The period 3 class level index is derived using the index for the new elementary aggregates along with the new weights for the elementary indices ([99.6 x 0.2] + [94.0 x 0.1] + [98.0 x 0.7] = 97.9).

Introducing new items and higher-level weights in the CPI in between basket revisions

8.27 The example of adding an elementary aggregate presented in Table 8.4 provides a method of introducing a new revolutionary item index, in this case for mobile phones within the COICOP classes 08.2.0 (handsets) and 08.3.0 (calls). The relevant class index now includes the contribution to price change of the mobile phones item within the class. The class, however, is likely to be under-represented within the corresponding groups (08.2 Telephone and Telefax Equipment and 08.3 Telephone and Telefax services), the division (0.8 Communication) and the overall CPI, because its weight does not reflect the increased expenditure resulting from the introduction of mobile phones. In most instances, statistical offices are hesitant to change the weights for the class, group, and division until a new set of weights for all items can be obtained from a recent Household Budget Survey. Statistical offices will typically include mobile phone handsets in class 08.2.0 and mobile phone services in class 08.3.0 without changing the weights for higher-level aggregates.

8.28 If the statistical office has no plans for conducting a Household Budget Survey in the near future and is concerned about the possible impact on the statistical integrity of the CPI from not changing the weights for the class, group, and division, there are alternative sources it can consider for updating weights. To update the weights for high-level aggregates, the statistical office first needs to estimate weights for each class within the group where the new product is added so that these class indices can be aggregated to the group level. Likewise new weights are needed for each group to compile the division-level index. In the example for mobile phones, each group within division 08 contains only one class so weights are needed for just groups 08.1, 08.2, and 08.3. The postal authority may be able to provide estimates of postal revenues for group 08.1. Importers of telephones, fax machines, and mobile phones may be able to provide revenue data for group 08.2. Regulatory authorities can be a source for revenue data on telephone and mobile services as well as internet fees. Alternatively, the national accounts may have expenditure data already compiled for these groups. The next step is to use the revenue information to calculate relative shares for each group and use the share weights to aggregate group indices to the division level. Note that the above procedure will still not be completely satisfactory if it does not incorporate, into Division 08, increases or decreases in the overall share of communications expenditures as a result of the revolutionary new product class.

8.29 Note also that the index compiler will need to judge whether it is appropriate to update all the above weights on an annual basis, subject to the availability of expenditure information from sources such as those described.

8.30 Countries which have participated in a recent International Comparison Programme (ICP) round might have the opportunity to use ICP expenditure data to derive new share weights at higher aggregate levels where further additional work, of relevance to a CPI, has been carried on expenditure shares to provide better and more robust estimates. For example, ICP data should be available at the COICOP division level and, if sufficiently timely, could be used to derive expenditure shares for each of the divisions. These shares can then be used to aggregate the division-level indices to compile the total CPI. For those divisions where no new items are added, the share weights within each level remain the same for aggregating item indices to the class level and class indices to the group level. Introducing new share weights at the division level, however, comes at a cost because it involves rebasing the index. The new weights cannot be used directly to compile the division 08 index and the all-items CPI. The statistical office must follow the procedures discussed in the rebasing section of Chapter 10 to introduce the new weights and to compile the division 08 index and the total CPI. This involves compiling the current and previous period division 08 index and the all-items CPI using the new weights, calculating the one-period price relatives, and then applying these price relatives to the previous period's published index for division 08 and the total CPI. This procedure must be used in all future periods also.

8.31 Table 8.5 contains an example of introducing new weights at the aggregate level when the new items for mobile phones have been introduced in groups 08.1, 08.2, and 08.3. The new share weights for these three groups in column 3 sum to 100. The price indices for period 1 (columns 4 and 5) below the total CPI level are the same, but they are aggregated using different weights. As a result, the index for division 08 (Communication) differs between column 4 (197.9) and column 5 (192.0). The total CPI also differs because of the different weights — column 4 (386.6) using the old weights and column 5 (393.4) using the new weights. As the difference between these values is solely due to weighting effects, the re-weighted index value should not be published - it should only be used to calculate the current period price change. Footnotes

should be provided to explain the introduction of the new weights.

8.32 To derive the period 2 indices for division 08 and the all-items CPI in column 7, the indices are compiled using the new weights and the price relatives between period 1 and period 2 (column 6) are calculated. The price relative for division 08 (0.999229) is applied to the period 1 published index for 08 Communication (197.9) to derive the period 2 Communication index (197.8). Likewise, the price relative for the total CPI (0.997954) in column 6 is applied to the period 1 published index for the Total CPI (386.6) to derive the period 2 All Items CPI (385.8).

8.33 These same calculations, using the price change in the re-weighted 08 Communication index and total CPI, are repeated for all future periods (see columns 8 and 9 in Table 8.5).

Geographical dimension

8.34 New products may appear in various markets at different times. For example, many products will first appear in the capital or large cities before being introduced (if at all) in smaller towns. Thus, it may not be feasible to add new products to all CPI areas at the same time. They may have to be introduced in different CPI areas gradually as their popularity spreads throughout the country. The above methods should be used to introduce new products in each CPI area as appropriate. For example, a new product may first be added to the capital city basket and then later to larger cities in other regions. It may never become popular in rural areas - in such a case, it should not be added to the rural basket. In principle, a household budget survey should provide the necessary background information, but the problem is that, frequently, rural areas are excluded.

Services Previously Provided Free

8.35 Sometimes services which have hitherto been provided free at the point of provision can become chargeable. Examples are the introduction of fees for the provision of certain health services, university tuition fees, and parking charges. The problem for the CPI compiler in these cases is two-fold:

- There is no weight in the base period (expenditure is zero).
- There is no base period price with which to compare the new price to create a price relative.

8.36 The solution is to go back to the standard Laspeyres index formula using quantity weights instead of expenditure weights, and using price levels rather than price relatives. The newly-charged product or service can be treated as if it were already included in an existing section (or item) index with a zero price but with non-zero quantity equal to its consumption in the base period. The index is then adjusted from the point of introduction of the positive new price to take on the new expenditure. The adjustment is as follows::

$$I_a = \frac{I_u \times EXP_u + 100 \times Q_o \times P_t}{EXP_u}$$

Where:
I_a *= adjusted index;*
I_u *= unadjusted index;*
EXP_u *= average weekly household expenditure in the base period for the index;*
Q_o *= quantity of the newly-priced service used in the base period; and*
P_t *= price of the newly priced service.*

8.37 In practice, it is not necessary to know Q_o and P_t explicitly if their product, the expenditure on base year quantity at period *t*, is known or can be estimated.

8.38 After an introductory period, the product may merit a separate index.

8.39 Some illustrative examples follow.

Eye-tests for adults

8.40 Assume that these were free until April 2007 but were charged for from that date on. The fees can be incorporated from that point by adjusting the paramedical services section index of the CPI (COICOP 06.2.3) to take account of the new charges for the remainder of 2007 until eye test charges can be introduced as a new item in that section in the usual way at the time of a regular updating of the CPI basket and chain linking.

8.41 The first stage in calculating the adjustment is to estimate the expenditure per CPI household arising from the introduction of eye test charges, for instance as implied by the number of free checks consumed in the base period. Price quotes can then be collected from opticians and the average price calculated. Where some people are still not charged for an eye test, for example those from poorer households, the number of tests paid for per CPI household can be estimated using official estimates of the proportion of adults paying for eye tests per year.

8.42 For instance, the number of eye tests paid for per index household per week may be calculated as:

$$\frac{0.22 \times 1.389}{52} = 0.006$$

Where it has been estimated from other data sources that:

22% of adults will pay for their eye tests (and 78% will continue to get them free).

The number of adults per CPI household is 1.389.

8.43 The expenditure per CPI household per week can be estimated by multiplying the average price of an eye test by 0.006.

8.44 The adjusted paramedical services (COICOP 06.2.3) index is then calculated using the formula already referred to above:

$$I_a = \frac{I_u \times EXP_u + 100 \times 0.006 \times P_t}{EXP_u}$$

Where:

I_a = adjusted index for paramedical services (COICOP 06.2.3)

I_u = unadjusted index for paramedical services (COICOP 06.2.3)

EXP_u = base period expenditure on paramedical services (COICOP 06.2.3)

P_t = average price for eye tests at month t.

University Fees

8.45 The introduction of student fees can raise a number of conceptual issues relating to the coverage of the index and the service paid for. Assume that from October 1998, the start of the academic year, new students on full-time higher education courses had to contribute up to $1,000 a year towards the cost of their tuition (rising to $1,125 a year in October 2003), the actual amount depending on their own and, if appropriate, their parents' or spouse's income. Previously, university education had been universally free.

8.46 There are four specific issues requiring consideration:

- *Index coverage*. The CPI is intended to reflect the average spending pattern of households. The definition of household in the case of students might be considered to vary according to whether they are:
    - Dependent on family or independent (depending on age and whether married).
    - Living at home or away from home.
    - If living away from home, whether they are living in communal or independent accommodation.

  But in practice, most households would regard dependent students as part of their household even if attending an institution away from home. This can justify a decision to treat all students in higher education as within the scope of the CPI. But the issue is not clear cut if the CPI excludes "institutionised" households.

- *Scale of fees*. In the case of goods or services provided or partly paid for by government, widely accepted CPI standards indicate that the amount relevant for inclusion in a CPI is the charge made at the point of acquisition or consumption, i.e. the amount actually paid by the individual household not the full economic cost of the service. In this particular example, it is assumed that students are liable for an amount between zero and a maximum set by the government depending on their own and/or their family income. The price recorded, and the index weight, should thus be the average of that actually paid by or on behalf of the students. The Ministry of Education may be able to supply forward estimates.

- *Timing*. The assumption is made that all fees are paid when billed although in practice it is possible that some students may pay some time after the due payment date. In this example, it may be assumed that fees are paid at the beginning of the academic year, and therefore included in the October CPI index.

- *Method of incorporation*. Initially, the index may be combined with private education fees, in order to compute an adjusted index as described in the earlier paragraphs. A decision then needs to be taken whether at some future point higher education fees and private education fees are represented by separate item indices. Two considerations apply: user needs and the robustness of the separate indices.

Parking charges

8.47 Assume that parking charges in the inner areas of the capital city were introduced for the first time in a country in February 2003, and were first included in the March 2003 CPI. Assume that at the time of introduction it is estimated that $110m will be generated over a year from a standard charge of $5 levied on cars while the annual revenues generated from charges which include a residents'

discount of, say, 90% is estimated at $6m. Also assume that it is estimated that there will be a 12.5% reduction in non-resident traffic and that in 10% of cases employers will pay the parking charges of their non-resident employees. It can be argued that as a CPI is a base-weighted, fixed basket index that does not take into account substitution away from a service as a result of a price increase, the estimated $110m from the standard charge should be increased, by the estimated reduction in traffic of 12.5%, to $125.71m.

8.48 This figure is then reduced by 10%, to remove revenue from parking fees paid for by employers, giving an annual expenditure of approximately $113.1m. To this must be added the $6m revenue which is raised from resident households giving a total of $119.1m. This is then converted into an estimated expenditure per CPI household per week, in this case 7.0 cents, if we assume that there are 32.57 million households in the base population.

8.49 This increased expenditure must be accounted for by adding it onto an existing sub-index. In this particular example, the most appropriate sub-index would be one covering other parking charges. If such a sub-index does not exist, then the most appropriate index in the same COICOP class should be chosen – e.g. road tolls for road bridges or motorways. If it is assumed that the base period expenditure on pre-existing parking charges is 28.7 cents per CPI household per week, then the combined expenditure, including the new parking charge, is 35.7 cents. Assuming no change in pre-existing parking charges, this gives an increase of about 24% in the sub-index, due to the introduction of the new parking charge, as shown below. If the index for the pre-existing parking charges is I_u, then, the adjusted index, I_a, is calculated as:

$$I_a = \frac{I_u \times 28.7 + 100 \times 7}{28.7}$$

8.50 The treatment of services previously provided free can be contentious. There is a lack of a universally accepted method and this can lead to inconsistent treatment. For instance, it can be argued that increasing the forecast revenue by the estimated reduction in usage, as in the parking charges example, is counter-intuitive to most users of a CPI and can be hard to justify.

Table 8.3 Example of sample rotation at the class level

Televisions

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index
Samsung 19" colour with remote	110.0	250	250	1.0000	110.0
Panasonic 21" colour with remote	105.0	300	275	0.9167	96.3
Philips 20" colour with remote	104.5	275	280	1.0182	106.4
Elementary Aggregate Index	106.5			0.9773	104.1

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Sony 25" colour w remote	104.1	600	600	1.0000	104.1	
Philips 25" colour w remote	104.1	500	475	0.9500	98.8	
Technics 27" colour w remote	104.1	475	475	1.0000	104.1	
Toshiba 27" colour w remote	104.1	550	560	1.0182	105.9	
				0.9917	103.2	0.5

Radios

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index
Sony portable	105.0	50	50	1.0000	105.0
Panasonic portable	100.0	25	20	0.8000	80.0
Technics portable	99.5	20	19	0.9500	94.5
Elementary Aggregate Index	101.5			0.9126	92.6

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Sony portable	92.6	50	45	0.9000	83.3	
Samsung portable	92.6	18	18	1.0000	92.6	
Philips portable	92.6	20	20	1.0000	92.6	
				0.9655	89.4	0.2

Tape recorders and players

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index
Yamaha tape deck (mini)	100	200	195	0.9750	97.5
Technics tape deck	95	125	125	1.0000	95.0
Elementary Aggregate Index	97.5			0.9874	96.2

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Sony Walkman	96.2	80	80	1.0000	96.2	
Samsung portable player	96.2	70	69	0.9857	94.9	
Panasonic tape deck	96.2	95	95	1.0000	96.2	
				0.9952	95.8	0.3

Class Index 102.8 99.4 98.2

09.1.1 Equipment for the reception, recording and reproduction of sound and pictures

Table 8.4 Example of introducing a new elementary aggregate

Telephones

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index	Weight in Class
Philips (Model 240 w memory)	110.0	50	50	1.0000	110.0	
Panasonic (Model 960)	105.0	30	27.5	0.9167	96.3	
Samsung (Model 520)	104.5	27.5	26	0.9455	98.8	
Elementary Aggregate Index	106.5			0.9534	101.5	0.6

Telephones

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Panasonic (Model 2000)	101.5	100	100	1.0000	101.5	
Sony (Model 1500)	101.5	90	85	0.9444	95.9	
Philips (Model 500)	101.5	75	75	1.0000	101.5	
				0.9811	99.6	0.2

Fax Machines

Variety	Period 1 Price Index	Period 1 Price	Period 2 Price	Period 2 Price Rel.	Period 2 Price Index	Weight in Class
Canon model 7160	100	2000	1950	0.9750	97.5	
Hewlett Packard model 5180	95	1250	1200	0.9600	91.2	
Elementary Aggregate Index	97.5			0.9675	94.3	0.4
						1.0000

Fax Machines

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Canon (Model 9900)	94.3	2500	2500	1.0000	94.3	
Samsung (Model 2800)	94.3	1500	1490	0.9933	93.7	
				0.9967	94.0	0.1

Mobile Phones

Variety	Period 2 Price Index	Period 2 Price	Period 3 Price	Period 3 Price Rel.	Period 3 Price Index	Weight in Class
Nokia (Model 14K25)	98.6	250	245	0.9800	96.7	
Samsung (Model 2J564)	98.6	180	180	1.0000	98.6	
Motorola (Model MI7J2369)	98.6	200	200	1.0000	98.6	
				0.9933	98.0	0.7
						1.0000

	Period 1	Period 2	Period 3
Class Index	102.9	98.6	97.9

08.2.0 Telephone and fax equipment

Table 8.5 Example of introducing new weights for higher-level aggregates

1	2	3	4	5	6	7	8	9
COICOP Code	Old Weight	New Weight	Period 1 Index (old wts)	Period 1 Index (new wts)	Price Relative	Period 2 Index (new wts)	Price Relative	Period 3 Index (new wts)
Total CPI	100.00		386.6			**385.8**		**386.8**
Total CPI using new weights		*100.00*		*393.4*	***0.997954***	*392.6*	***1.002562***	*393.6*
01 Food and Non-alcoholic Beverages	67.29	58.23	345.2	345.2		342.5		343.7
02 Alcoholic Beverages and Tobacco	0.54	0.77	453.2	453.2		455.1		454.1
03 Clothing and Footwear	1.37	1.70	376.9	376.9		375.0		376.0
04 Housing, Water, Electricity, Gas and Other Fuels	7.91	8.45	572.4	572.4		576.8		577.2
05 Furnishings, Household Equipment and Routine Household Maintenance	2.54	2.71	401.5	401.5		402.0		402.8
06 Health	1.47	2.12	215.1	215.1		217.3		217.3
07 Transport	6.06	8.25	685.9	685.9		687.7		686.5
08 Communication	2.14		197.9			**197.8**		**197.5**
Communication using new weights		*4.15*		*192.0*	***0.999229***	*191.8*	***0.998570***	*191.5*
08.1 Postal Services	0.47	0.24	201.1	201.1		201.1		201.1
08.2 Telephone and Telefax Equipment	6.54	37.35	179.8	179.8		177.9		177.5
08.3 Telephone and Telefax Services	92.99	62.41	199.2	199.2		200.1		199.9
09 Recreation and Culture	1.79	2.55	348.2	348.2		349.6		350.3
10 Education	1.43	1.98	433.7	433.7		433.7		435.9
11 Restaurants and Hotels	3.41	5.67	411.2	411.2		413.2		415.5
12 Miscellaneous Services	4.05	3.42	391.3	391.3		393.1		397.8

CHAPTER 9.1

Special Cases - Housing

Introduction

9.1.1 Paragraphs 10.4 to 10.50 of the ILO Manual give a detailed exposition of the conceptual and practical issues relating to the measurement of owner-occupier housing costs. The manual is not prescriptive in recommending a particular approach but does recommend that "the approach chosen should align with the conceptual basis which best satisfies the principal purpose of the CPI". It also makes the point that alternative conceptual treatments can have a significant impact on measured inflation in the short-term. Like the Manual, the 2003 ILO Resolution is not prescriptive. The treatment of rented accommodation is considered straightforward and not to warrant special mention. This section first looks at the treatment of owner-occupier housing costs and then at the costs borne by tenants. The latter are often used to impute owner-occupier housing costs.

Owner-occupier housing costs

9.1.2 The treatment of owner-occupied housing is one of the most difficult issues faced by compilers of consumer price indices. There are a number of alternative conceptual treatments and the choice between them can have a significant impact on the overall index, affecting both weights and, at least in the short-term, the measured rate of inflation. Some of these costs, namely the expenditure on minor repairs and maintenance, local property taxes and the costs of services are straightforward, can be directly measured and there is no reason to introduce a special methodology outside the usual CPI protocols. However, as regards the main elements of owner-occupier housing costs – the purchase of the property and to a lesser extent, the depreciation cost or cost of major repairs - there is no universally accepted method of treatment. The absence of any firm consensus concerning the appropriate treatment of such costs partly reflects the fact that national CPIs are often constructed to serve several distinct purposes, from monitoring the economy to adjustment of incomes or state benefits. National housing market structures and practical measurement issues are also important considerations in determining which approach to apply in practice.

9.1.3 In a national context the inclusion of owner-occupier housing costs will improve the representativity and relevance of a CPI. When used in an international context, for example to measure economic convergence, the inclusion of owner-occupier housing costs should, in principle, enhance the comparability of national CPIs across countries. However for this purpose two major concerns have been expressed. First, including owner-occupier housing costs could impact on the inflation rate and its volatility. Secondly, it could add to cross-country divergence in inflation rates and may make it more difficult for an individual country to meet inflation convergence criteria set for a block of countries, due to differences with regards to the relative importance of each country's owner-occupier housing market and divergences in the respective movement in house prices across countries. This could be the case, for instance, if an inflation target was set by the European Central Bank for the Euro-zone, which included owner-occupier housing costs.

9.1.4 It can also be noted that, depending on the methodological approach used, data on owner-occupier housing costs may be not as timely as other data for the CPI and the compilation of representative owner-occupier housing costs indices might only be feasible on a quarterly basis. Both aspects would impact on the underlying statistical quality and usability of the CPI.

9.1.5 All these considerations need to be taken into account by a national statistics institute in deciding which approach to adopt once a decision has been made to include owner-occupier housing costs. The criteria for choosing which approach will include: alignment with user needs and the main purpose of the CPI; consistency with the rest of the CPI; alignment with international practices (although in the case of housing costs there is no unique agreed methodology); public acceptance; practicality of implementation.

The different conceptual approaches

(1) Acquisitions approach

9.1.6 This measures the price of purchasing owner-occupier housing irrespective of how such purchases are financed. Acquisitions can be measured on a gross basis (i.e. the total value of purchases) or on a net basis (i.e. purchases minus sales).The net basis is often consistent with the treatment of other consumer durables such as cars where there can be a large and active second-hand market (see Section 9.6 on second-hand goods). A comprehensive acquisitions index would cover the cost of extensions and conversions (for example, where a single occupancy house is converted into flats) and would also make a separate allowance for the transaction costs of house purchase including legal fees.

(2) The payments approach

9.1.7 This covers the expenditure actually incurred in occupying the house. It includes, among other elements, measuring the interest payments made on loans to purchase the house, i.e. mortgage interest payments.

(3) The user cost approach

9.1.8 This measures the changing cost of using owner-occupier dwellings. The usual way for accounting for this in a CPI is to treat it as the rent the owner, as tenant, notionally pays himself, as occupier – the rental equivalent or imputed rent[23].

Practical options

9.1.9 In practice different countries use different approaches. The choice of approach will depend on such factors as what is viewed as the main purpose of the index and data availability. Based on the above conceptual breakdown, and taking them in reverse order, the methods fall into three distinct types, namely:

- Those which estimate the "equivalent" rent of the house, i.e. the rent that it might be expected to fetch in the market. Such estimates are called imputed rents. User costs are represented by the imputed rents. This approach is particularly dependent on a reliable source of information on rents.
- Those which estimate the shelter costs by reference to the expenditures that the owner-occupier faces such as mortgage interest payments and major repairs. This is most appropriate for a cost-of-living index. This approach requires detailed information on outstanding mortgage debt and a regular and reliable index of house prices.
- Those which represent the net acquisition cost, that is, the cost of acquiring properties which are new to the owner-occupier housing market. It treats the purchase of a house exactly like any other purchase. It doesn't consider how the purchase of the house is financed and therefore does not include an element relating to interest rates. It is most appropriate for a CPI constructed as a general economic indicator, for example, for monetary policy. It requires an index relating the price of new houses and, depending on the exact methodology adopted, separate indices and weights for the cost of the land and the cost of the building. As with (2) above, the cost to owners of all major repairs, associated with the depreciation of all current dwellings, should also be included in the CPI. For instance, it is appropriate to include the cost of acquiring a new roof for a current dwelling.

9.1.10 The reasoning behind (1) - the rental equivalent approach - is as follows. The owner-occupier can be considered as consuming the value of the shelter provided by his house in the same way as a tenant consumes the value of the shelter of his accommodation for which he pays rent. Accordingly, as parallel to the rent a tenant pays, a rental equivalent or imputed rent should be estimated for the value of the shelter consumed by the owner-occupier. Under this approach the cost of major repairs should not be measured separately if the terms of the leases for rented property indicate that the landlords are responsible for such costs and so they are covered under the rental equivalent. The main criticism of this approach is that movements in rents may not shadow owner-occupier costs. This is particularly so where rented housing and owner-occupier housing are distinct markets, for example where rent controls apply, where rented housing is of a different type or in a different location than the owner occupied housing, or where there can be significant short-term fluctuations in interest rates. However, the conceptual attraction of using imputed rents, in particular the parallel drawn between somebody buying and somebody renting a property, is recognised. In addition, compared with the other

[23] An alternative way of applying user cost is to estimate the opportunity cost which is based on measuring the flow of services which the home owner receives from the asset. It involves estimating the opportunity cost involved in tying up capital in bricks and mortar (net of capital gains) rather than in investing in some other financial asset. It is not a method which has found practical application in CPIs due to the challenges of coming up with a detailed definition and a practical method of application which is not too judgemental.

two methods, it is more likely that there are data which can be readily drawn upon to construct the appropriate weights and the price index. The price measure would be the change in the average equivalent rent for properties similar to those which are owned i.e. a sample of private rents appropriately stratified and weighted, and the weight would be the average equivalent rent for owner-occupied homes in the base period, imputed on the basis of actual rents for private rented dwellings, adjusted at least in theory to allow for any quality difference between owned and rented property. More detailed guidance on the application of this approach is given below in paragraphs 9.1.13 to 9.1.18.

9.1.11 Moving on to option (2) - the payments approach - it is sometimes argued that this option is more consistent with the traditional approach to CPI construction, which is a carry-over from a time when the CPI was mostly used as a compensation tool. It also has much to commend it from the point of view of public acceptability. It measures costs directly, thereby avoiding imputation. In addition "mortgage interest" is more likely to be understood than "rental equivalence" and, unlike the latter, the index will reflect changes in house prices and interest rates. But there are also issues relating to (2). The items of direct expenditure by purchasers of property are: mortgage interest payments; repayment of capital; large repairs (associated with depreciation from wear and tear as properties get older). A CPI should only relate to consumption items and should exclude cash disbursements or expenditure which is in the nature of a saving or "investment" and the acquisition of a house will normally over a period of time represent a substantial capital asset – a point which emerges when comparing the position of owner-occupiers with tenants who rent. It can therefore be argued that the capital element of mortgage repayments should be regarded as an investment or saving rather than consumption expenditure and should therefore be excluded from the index. The question arises over whether the weight and price indicator should be net of any tax allowances for mortgage interest payments. It is recommended that in accordance with the principle that a CPI should be based on the amounts actually paid the weight and price indicator should both be based on payments after tax relief. Perhaps the biggest barrier to the adoption of this method is that it requires a large volume of data, which may or may not be available to the compiler. Mortgage interest payments will be affected by changes in both interest rates and house prices in different ways. Changes in interest rates will affect all of those buying a house apart from those on fixed-interest loans, while changes in house prices will affect only those buying a house in the current period. Thus a price indicator consisting of the current interest applied to a standard-sized mortgage to a standard-sized house would not be appropriate. An appropriate indicator involves two components - the rate of interest and the average amount of mortgage debt outstanding. To calculate the average outstanding debt at any one point in time can be problematic as it consists of a large number of individual debts, some from mortgages taken out recently and other from mortgages taken out some time ago at historic prices and with some of the debt paid back. It is unlikely that all countries, and most developing countries, will have the necessary data to apply this method. Returning to more fundamental issues, some argue that the problem with this approach is that it includes a major (explicit) cost of owning a home, namely mortgage interest, but it does not include a major offsetting (implicit or imputed) benefit, namely possible price appreciation or capital gains on the home. This neglect of this benefit is particularly troublesome when there is moderate or high inflation in the economy: the observed mortgage interest cost can increase compared with other costs and give a very misleading picture of the homeowner's true long run costs of living in the home (because the offsetting benefit is neglected). But the counter-argument is that the capital gains of owning a house which appreciates in value is of limited relevance when people have to bear such costs from current income. This is, perhaps, a case where the measurement approach which is adopted will vary depending on the use and purpose of the CPI.

9.1.12 The argument in favour of (3) - the net acquisition approach - is that it is the closest to the "acquisition" approach which has traditionally been adopted for other parts of a CPI and is more appropriate for a CPI being used as a general indicator of current economic conditions. But the method draws considerable criticism from those who require a CPI as a compensation index, as neither the weight nor the price indicator properly reflect the shelter costs of owner-occupiers. For instance, a rise in interest rates would not be reflected in a net acquisition cost index. Also there is a lack on consensus about whether the price of land should be included or excluded. It has been argued that in principle the cost of the land should be excluded because it is a non-depreciating capital asset, i.e. it represents the capital element of the house purchase, and similar to the treatment of capital repayments on mortgages should be regarded as an investment rather than consumption expenditure. It is important to remember that in the

System of National Accounts dwellings are treated as capital, not consumption, items. Some countries use this argument to exclude the acquisitions approach as a valid method for a CPI.

Rental equivalence (imputed rents) – an option for many developing countries

9.1.13 For many developing countries a significant proportion of the housing stock consists of newly constructed buildings on family owned land or of old stock which has been significantly upgraded. There can also be a significant element of owner-constructed housing. Construction may take many years and at any time a significant proportion of the houses could be considered incomplete. The use of formal mortgage finance is often very limited but informal finance may be used. House construction can vary from shanties built on compacted soil with salvaged materials to substantial multi-room dwellings built on concrete foundations with concrete blocks. Amenity levels can vary from virtually none to the elaborate. Housing mobility, particularly with owner-constructed dwellings, is usually very low and consequently the markets for rental or sale of owner-constructed houses are limited and there is very little movement between the two. However, in principle the estimation of the price of owner-occupied housing services is the same for owner-constructed housing as for third party constructed housing but the measurement problems are accentuated.

9.1.14 The above complications mean that formal records will rarely be kept of the cost of building the new dwelling or of upgrading an old house, for example, by incorporating running water, an internal WC or additional rooms. Formal transfers of ownership sometimes do not take place, formal valuations are often not available and methods of financing can be informal through the family or may simply not be recorded or records not kept centrally. Thus in these circumstances it is not possible to calculate mortgage interest payments (including or excluding notional interest payments to relatives), or to estimate net acquisition costs.

9.1.15 The lack of such basic information often means that the rental equivalence or imputed rent approach is the only practical option for incorporating owner-occupier housing costs in a CPI, whether owner-constructed housing or third party constructed.

9.1.16 The price indicator for imputed rents can be derived either from a readily available price series for rents, weighted to reflect the current composition of the stock of owner-occupier housing, which can then be applied to the rental equivalents in the base period, or from asking an expert to provide on a monthly basis the current equivalent rents for a sample of houses with different characteristics which are "representative" of the owner-occupier housing stock. More advice on rent surveys is given later on in this section where the measurement of the costs borne by renters is discussed.

9.1.17 In each case, stratification by type of dwelling (house or flat), location (region or area, urban or rural), plus other characteristics which will influence rent is important so that the rents data can be combined to reflect the overall composition of owner-occupied property. Other stratification variables will include such things as the total size of the plot, floor area and number of rooms, whether there is mains water, an internal WC and mains electricity, the material used in construction and whether the building is of traditional design. The price statistician should seek the advice of an expert active in the field of renting domestic property, such as a housing corporation, to ascertain the most important rent-determining characteristics and should bear in mind the need to keep these to a manageable number. Weights information can be derived from the latest Housing Census or Census of Population and Housing. In practice this information may not be up-to-date due to the change in the owner-occupied housing stock which can occur in the time period between censuses. Where this is the case special surveys may need to be conducted or, particularly in urban areas including townships, use made of planning applications to update the latest census.

Double counting

9.1.18 Where expenditure on repairs, maintenance, local property taxes, water charges etc. are included in rents, these costs should not be included elsewhere in the index. Thus it is important that Household Budget Surveys determine if the renter household receives any additional services, such as electricity or use of facilities outside the housing unit, such as off-street parking. It is also important to learn if the household must pay any additional costs, such as taxes, that the owner of the dwelling does not pay. The value of any supplementary items provided and the cost of any items borne by the tenant should be allocated to their proper CPI category. For example, the dwelling may have water supplied at cost by the landlord: in this case, CPIs may either leave landlord-supplied water in the rent or move an estimated value for it from the rent index to an index for water, but this must be done consistently in the weights and the rent survey. Leaving supplementary items in the

rent avoids the need to adjust the weight, but leaves the potential problem that if the landlord ceases to provide them, the CPI compiler will need to adjust the values of the rents collected in the rent survey.

Rented accommodation

9.1.19 Unlike owner-occupiers, renters buy shelter from others who own the dwellings that the renters occupy. Consequently, there is a market transaction to observe and the cost of rented accommodation is relatively easy to observe in the market.

Weights

9.1.20 Obtaining the weight for renter-occupied housing in the CPI basket is relatively straightforward. Household Budget Surveys (HBS) typically collect data from households at their place of residence. The surveys obtain the rents from those residences that are renter-occupied, and the statistical offices estimate the annual expenditure on rents using standard methods. The HBS should also inquire whether the household rents other housing in addition to its main residence, perhaps near to a job or in a holiday location.

9.1.21 It is important that the HBS determines if any additional services are included in the rent. This is to ensure that no double-counting takes place and that a consistent approach is taken on where the expenditure is accounted for in the CPI (see earlier section).

Prices – rent surveys

9.1.22 The rent to be recorded is the amount that the household actually pays including taxes and excluding subsidies. If the rent is subsidized or taxed, the amount the household pays will not be the same as what the landlord receives so although information on rents may be collected from any knowledgeable respondent – this may be one of the dwelling's occupants, its landlord or the landlord's representative, the latter two can be problematic for a CPI. In order to respect the "fixed basket" principle of the CPI, an effort should be made to continue collecting prices from the same dwelling units over time. Despite the perceived difficulties, a longitudinal survey of rental units will often be the best solution to ensure that the proper rents are collected[24].

9.1.23 Alternatively, it may be possible to collect rents from an existing continuous household survey such as a labour force survey. In this case a specific rent-based auxiliary questionnaire can be distributed to those tenants who participate in the main survey. Clearly the respondent should be knowledgeable. For example, some occupants may not be the ones who actually pay the rent and may be quite unsuitable as respondents. The important feature of any such survey is that it provides rents at multiple time intervals but because people may move it will not necessarily follow the rents of a fixed basket of housing units. In these circumstances, the rent data should be stratified by rent-determining characteristics, so that the average rent increase for a house with pre-assigned characteristics or for a "fixed basket" of house types can be determined.

9.1.24 If rents change rather infrequently, it may be more efficient to use a relatively large sample collected less frequently than every month even though the CPI may be computed monthly.

9.1.25 Where a survey of rental dwellings is undertaken a sample can be drawn from any frame that contains the residential units of an area. This may be the Census of Population (if it has a shelter component), postal lists, or street directories.

9.1.26 If the population census can provide information on the average rent or dwelling value by geographic area, sampling of the areas by probability proportional to rent/value will increase the final sample's representativity. Where a sampling frame is not readily available, a grid can be placed on a map of the area and a sample of cells in the grid can be selected. The grid method can also be used as a second stage of sampling after selecting larger areas using available information on rents or values. Several countries, including developing countries, have used satellite images of the selected areas to obtain an accurate view of the housing in the cells or target areas. Ideally, all the dwellings in the selected cells should be enumerated and from this a random sample selected for the data collector to visit to determine if they are tenant-occupied, and, if so, to obtain their rents and initiate them into the sample. The initial selection of target areas for enumeration should be small enough to be manageable and relatively homogeneous and large enough to allow for a big enough initial sample selection to allow for non-response and the fact that some dwellings will be owner-occupied. Where an enumeration exercise is not possible, for example because of the cost, judgmental or purposive sampling may be used but in this case it is particularly important that the individual cells on the grid are relatively homogeneous, i.e. that there is little variation in the type, size and quality of the dwellings, in order to

[24] With longitudinal studies, the same units are observed at regular intervals over long periods of time.

minimise the potential for drawing an unrepresentative sample.

Calculating the rent index when data collection is less frequent than monthly

9.1.27 As previously mentioned, spreading price observations by pricing the rent for a particular dwelling less frequently than monthly (i.e. pricing a sub-sample of rents each month) is a strategy that can be used for increasing the sample without necessarily having to allocate more resources to the collection exercise. In some cases, the statistical quality of the rent change estimate can even be improved by applying this approach. The trade-off is a lag in the index and a muting of any seasonal effects (which are rare in most areas). If most rents change traditionally in the same month each year, say for example in January, using this method will spread the January rent change over the next twelve months.

9.1.28 Where monthly rent changes are not obtained monthly for the full sample of dwellings, the rent index from months *t* to *t - 1*, $\Delta_{Rent}^{t-1\to t}$, can be derived from a sub-sample of rental units for that month. To obtain the full estimates of rent change over longer periods, the values from the different monthly sub-samples are chained together in succession.

9.1.29 To calculate the monthly rent index with a sub-sample of units, $\Delta_{Rent}^{t-1\to t}$, the same set of rental units is priced at intervals ***m*** months apart. The monthly change obtained at time *t* is the m^{th} root of the sum of the weighted sample rents in period ***t*** to the sum for the same dwellings in period ***t-m***:

$$\Delta_{Rent}^{t-1\to t} = \sqrt[m]{\frac{\sum_i \left[w_i \times r_i^t \right]}{\sum_i \left[w_i \times r_i^{t-m} \right]}}$$

Where:

$\Delta_{Rent}^{t-1\to t}$ *= change in rents from period t-1 to period t*

r_i^t *= the rent of sample dwelling i in period t*

r_i^{t-m} *= the rent of sample dwelling i in period t-m, (the last time a rent for that dwelling was collected)*

w_i *= the optional weight of sample rented dwelling i*

9.1.30 It can be noted that sample weights may be ignored for simplicity if the sample rental dwellings represent roughly the same number of rental dwellings in the sampling frame. Equivalently, one can set the weights in the formula to "1" in most cases - this will provide a mechanism to handle non-response and sampling anomalies appropriately.

9.1.31 Note, geometric rather than arithmetic averages can be taken in the above formula to avoid the defect of the Dutot index; i.e. that it is not invariant to changes in the units of measurement of the dwellings or, more to the point in the present context, very expensive dwellings will get a large implicit weight. Alternatively expensive dwellings can be treated as outliers and be excluded from the calculation.

Accounting for missing observations

9.1.32 When a dwelling from a cell is a non-response because of a temporary failure to collect the information (perhaps the data collector was not able to contact the respondent) but data relating to the other dwellings in the cell were collected, the collected dwellings should be given the weight of the missing unit. For example, if there are three assigned dwellings in a cell each with a weight of 1 (because they are equally weighted) and two are collected and one is not, the rent of the missing dwelling can be imputed from the two that are collected as follows:

$$\hat{r}_{missing}^t = r_{missing}^{t-m} \times \frac{r_{collected\,1}^t + r_{collected\,2}^t}{r_{collected\,1}^{t-m} + r_{collected\,2}^{t-m}}$$

9.1.33 If all observations in a cell are missing, perhaps because of a data collection problem, they can be omitted from the calculation this month, but their rents must be estimated for use the next time. If a rental dwelling is a non-response in period *t*, its imputed rent for period *t* is as follows:

$$\hat{r}_{missing}^t = r_{missing}^{t-m} \times \left(\Delta_{Rent}^{t-1\to t} \right)^m$$

9.1.34 This imputed rent is not used until period t+m. Notice that it cannot be computed until after period *t*, when the value for $\Delta_{Rent}^{t-1\to t}$ is known.

9.1.35 Where dwellings become unsuitable for inclusion in the CPI – for example, they become uninhabitable, perhaps because of a fire - they can be dropped from the sample (if deemed unlikely to be repaired) or, if there is reason to believe they will be repaired and returned to use, treated as non-response.

9.1.36 Dwellings that cease to be rental dwellings – for example, they become owner-occupied or are converted to non-housing use - are dropped from the sample, but it is good practice to find a replacement dwelling nearby, if feasible. Until the replacement dwelling can be used in the index the old dwelling should be treated as a non-response.

9.1.37 It should be noted that geometric imputation is more desirable if a Jevons index is being constructed at the elementary level as geometric imputation is consistent with the Jevons formula. The use of geometric weighting also avoids the problem previously referred to of large expensive houses dominating the calculation.

Updating the sample

9.1.38 The rent sample, like all CPI surveys, needs to be kept up to date. This is especially important if there is new construction of rental dwellings. An entirely new sample can be drawn at one time, run in parallel with the old one, after which the old one can be dropped. The new sample should be based on a new sampling frame. Deploying an entirely new sample at one time can be quite expensive. An alternative is to replace part of the sample each year. If the rent sample uses several sub-samples, the natural way to do this is to roll in one sub-sample per year. For example, replace the January/July sub-sample one year and the April/October one the next year. Select the new area cells and assign them to sub-samples all at one time, but then limit the data collection work to one sub-sample at a time. Rents for the old and new sub-samples need to be collected at the same time so that the new sub-sample is spliced in using the overlap method - the CPI uses the old sub-sample for the last time while collecting the initial rents for the new sub-sample.

9.1.39 The index is a chaining of the rent change values:

$$I_{Rent}^{t} = I_{Rent}^{t-1} \times \Delta_{Rent}^{t-1 \to t}$$

Depreciation, major home improvements and quality change

9.1.40 Sample rental dwellings can change between visits from CPI data collectors. Sample dwellings that undergo dramatic changes - either improvements or deteriorations - are best dropped from the sample, at least temporarily. More subtle changes affect all dwellings: they get older and depreciate. Regular maintenance - for example, replacing the roof - offsets this phenomenon to some extent at least. Some countries make an explicit quality adjustment to observed rents to take into account the fact that a rental dwelling that is older has depreciated and hence is generally not as desirable as it once was. However, an older property does not necessarily become less desirable especially where it is properly maintained. In the case where money is spent on a property for the repairs needed as a result of depreciation as the property gets older, care should be taken not to double count these ongoing and long-term maintenance costs associated with depreciation as they will sometimes be reflected in the overall level of rents charged. Only the costs of repairs and maintenance for which the tenant is responsible should be included in the CPI and these can be obtained through the regular CPI survey of prices as with any other household expenditure. A study of rental agreements between landlord and tenant should provide the information needed to identify whether the dwelling is depreciating and which maintenance costs should be covered by the price survey.

9.1.41 Empirical estimate of the net depreciation of dwellings generally, including those of owner-occupiers, find that it can be small, at least in the short-term, so that where depreciation is measured neither directly nor indirectly, ignoring it should not be too problematic for users of a CPI who are interested in inflationary trends in the short-term. The compiler should nevertheless be aware of this phenomenon.

9.1.42 As mentioned earlier, for owner-occupied dwellings there is no universally accepted method of treatment of the quality change associated with depreciation or the cost of major repairs.

CHAPTER 9.2

Special Cases - Own Account Production

Introduction

9.2.1 Own production is considered within the scope of the CPI and can account for a significant proportion of a country's household consumption. However, as discussed below, there are components of own account production that are never included in the CPI and other components for which alternative treatments are possible. The issue is discussed at length in the CPI Manual, (paragraphs 1.175 to 1.182 and 3.74 to 3.89). Before considering what is excluded and the options available for the part of own account production that may be included within the scope of the CPI, it is necessary to distinguish a number of concepts and to explain some of the problems and choices that must be addressed.

9.2.2 The Manual makes a distinction between:

- Intermediate consumption. In the context of own account production, this refers to the goods and services which households use in the process of producing other goods and services.
- Final consumption. Correspondingly, this refers to goods and services produced for direct consumption where utility is derived by the household through the act of consumption.

It goes on to indicate that in principle a CPI should measure output prices in respect to own account final consumption but notes conceptual and practical difficulties with this, associated with the fact that there are no transactions or prices. The CPI Manual then points to the more practical option of using goods and services acquired in the market place as a proxy for household production activities as if they themselves were final consumer goods and services. But it also points to the special problems associated with subsistence agriculture and housing.

9.2.3 The ILO Resolution is not prescriptive on the inclusion of own account production in a CPI but does advise that "when the consumption from own account production is within scope of the index, the weights should be based on the value of quantities consumed from own production" and that "valuation of consumption from own account production should be made on the basis of prices prevailing on the market, unless there is some reason to conclude that market prices are not relevant or cannot be reliably observed or there is no interest in using hypothetically imputed prices". This chapter discusses these issues in more detail.

Background

9.2.4 Goods and services produced by households for their own consumption are called own account production. Own account production may be considered within the scope of a general consumption CPI and should not be ignored especially where it can account for a significant portion of a country's household consumption. However, for practical reasons, own account production of services is excluded from the scope of the CPI.

9.2.5 In some developing countries most households report some own-account production. Food is the area where this is most frequently observed. For instance, it is not uncommon for 50 percent and more of food consumed to come from own production in some developing countries. For low-income households living in rural areas, the share can be much higher. Own account production is therefore a particular issue for poverty analysis.

9.2.6 Three broad areas of household own account production can be distinguished:

- *Goods produced for own consumption*. These goods are mainly produced by subsistence households. They include basic food items such as rice, wheat or maize, vegetables, fruit, dairy products, fish and meat. Some households may also produce clothing and items of furniture for their own use.
- *Owner-occupied housing services*. These services are produced by all households that own[25] the dwelling in which they live. See Chapter 9.1.
- *Own account household services* (excluding owner-occupied housing services). These services are produced by all households. They

[25] This includes households that are purchasing their house using a mortgage.

include the preparation of meals, the care of children, the sick and the elderly, cleaning and maintenance of dwellings and the transport of household members.

9.2.7 None of these goods and services is *purchased* by households. They are *consumed without the need to purchase* because they are produced within the household.

9.2.8 As already indicated, own account production is significant in all countries; for some countries goods agriculture, particularly subsistence agriculture, are important and for others owner-occupied housing is important. The importance of these areas of production changes over time, both within countries and between them. Structural changes to the economy may lessen or increase dependence on these areas of own account production. Subsistence agriculture is particularly vulnerable to short-term impacts from climatic and other factors. Both subsistence agriculture and owner-occupied housing are subject to long-term changes in the economy. Within a country, comparisons over time can be significantly affected by such changes. Similarly inter-country comparisons will be affected by the changing role of own account production in national economies.

9.2.9 Before considering own account production in detail, three further distinctions are necessary.

- Goods and services that are used for satisfying the immediate needs or wants of households or the community are called *final consumption*. If a person buys an ice-cream or a haircut that is final consumption.
- Goods and services that are used for producing other goods and services are called *intermediate consumption*. Milk, cream and flavouring used by the ice-cream factory to make ice-cream is intermediate consumption. As will be seen later, households also can have intermediate consumption.
- Goods purchased to be used repeatedly over extended periods are not immediately consumed but provide benefits to the owner over the lifetime of the goods. These goods are called assets or *gross fixed capital formation*. For example, a house will normally provide shelter for many years. Similarly a stove may provide cooking services for decades. A house is treated as capital formation in the SNA and is subject to special treatment in the CPI, depending on the approach chosen (i.e., acquisitions, uses, etc.). However, other capital goods (such as stoves, cars etc., which are commonly referred to as "household durables") are treated in both the CPI and the SNA as though they are fully consumed in the period in which they are purchased rather than being depreciated over time, so their price is included in the CPI in the period in which they are purchased.

9.2.10 Goods can fall into all three categories. However, services can only be intermediate or final consumption: they are consumed as they are produced. The distinction between final consumption, intermediate consumption and gross fixed capital formation lies at the heart of understanding the statistical treatment of own account production.

The own account production dilemma

9.2.11 *In principle* a CPI should measure the prices of final consumption by a household. For purchased final goods and services this is not a problem as the price is determined at the time of purchase. For example, if a person buys a newspaper or a haircut, the price is quite clear. However, for goods and services produced and consumed by a household there is a problem. Because no purchases are involved there is no direct price to measure or expenditure. For example, if a family has a cow the family does not pay for the milk that the cow provides. If a family owns the house in which they live, they do not pay any rent for the house even though they obtain the same benefits as their neighbour who is renting. As discussed later, indirect measurement of prices is possible for both the goods produced for own consumption and the owner-occupied housing services.

9.2.12 The dilemma for own account household services (excluding housing services) is greater because even indirect measurement of the price of the services is not practical. For example, there is no practical way of putting a price on the services provided when members of the household care for their children, the sick or the elderly. Similarly there is no practical way of putting a price on home cooked meals or on clean houses. The ingredients purchased for use in the preparation of a meal or the cleaning materials used to clean a house can be readily priced. In principle they are *intermediate* consumption whereas the CPI compiler should be pricing the *final* consumption, in this case the home cooked meals or the service provided when a house is cleaned[26].

[26] See paragraphs 1.177 and 1.178 of the CPI Manual

9.2.13 *In practice,* CPI statisticians have several options. For the first two categories, goods produced for own consumption and owner-occupied housing services, statisticians can measure output prices indirectly or they can measure some (but not all) input prices and use them as a proxy for the prices of the goods and services consumed. The CPI Manual offers a choice of indirectly measuring output prices (the conceptually preferred method) or of pricing the inputs (in some circumstances the more practical approach). The System of National Accounts 2008 (SNA 2008) recommends the indirect measurement or imputation of prices to the outputs of both areas. For the third category, the remaining own account household services (excluding housing services), it is not practicable to put a value on this consumption. In recognition of the difficulties in valuing household services (excluding housing services) the SNA classifies this category as outside the national accounts "production boundary" and treats the goods used (food, cleaning materials etc.) in producing these services as household final consumption expenditure. Similarly, the CPI Manual recommends treating the goods purchased by households for use in preparation of household services as consumption rather than the household services produced (meals, house cleaning etc.).

9.2.14 There follows in the next section a discussion on goods produced for own consumption. It considers how goods produced for own consumption might be treated in the CPI, how the 'weight' and 'price' of this consumption can be estimated, and the relationship of such estimates to other statistical series.

Goods produced for own consumption

9.2.15 In many countries a majority of households produce some goods for their own consumption. For urban households the quantities produced may be relatively insignificant and generally are not worth attempting to measure. However, other households, particularly subsistence farming and fishing households, depend on the food they produce. Such households produce most or all of the food they consume.

The scope and choice of index

9.2.16 The precise scope of a CPI is influenced by what is intended to be the main use of the index. While the general purpose of a CPI is to measure changes in the prices of consumption goods and services, it is necessary to decide whether the index is meant to cover the consumption of all consumers or to be restricted to the consumption of a particular group. It is also necessary to define precisely which goods and services will be measured[27].

9.2.17 Consider the household scope and the consumption scope of the CPI. Subsistence households generally have a weak connection to the monetary economy. A major part of their consumption is from their own or bartered production. Generally indices designed for the indexation of wages or benefits exclude subsistence households from their scope. For simplicity of the following discussion, these will be referred to as "compensation indices". Indices designed to measure price changes covering all monetary transactions will include monetary purchases by subsistence households but will not include subsistence consumption. These can be referred to as "monetary indices". There is a third type of index which includes subsistence consumption within its scope. These can be referred to as "general consumption indices".

9.2.18 For countries where subsistence consumption represents a major part of total consumption, the three types of index will behave differently when the prices of basic foodstuffs, imported manufactured goods, and farm inputs diverge. In such circumstances an index that excludes subsistence households will not be nationally representative as it is designed to be representative of the price experience of a more limited group of households. Similarly, the monetary transactions index and the general consumption index will give divergent results. Each index provides a different picture of what is happening within the economy. The first does not attempt to be nationally representative and the remaining two indices attempt to be nationally representative but in different ways.

9.2.19 To understand the differences in these indices consider the following example. Assume drought affects a country with a high proportion of subsistence households. Assume non-subsistence households are included within the scope of the compensation index and have no subsistence consumption. These households are also affected by the drought but to a lesser extent. Assume that the price of basic foodstuffs increases sharply, that there is relatively little change in the prices of imported manufactured goods, and that the prices of farm inputs fall due to a sharp fall in demand from subsistence farmers[28]. In this example the

[27] For a detailed discussion of scope and related issues see Chapter 2 of this Handbook and Chapter 3 of the CPI Manual.

[28] Many different scenarios could be considered. This example is designed to show that all three index types are sensitive to the

compensation index will rise because basic foodstuff prices cost more, but the rise will be moderated because the price of imported manufactured goods has not increased to the same extent. The rise in the monetary index will be moderated further because of the fall in the price of farm inputs. The general consumption index will show the greatest increase because the weight given to basic foodstuffs will be much higher, reflecting subsistence consumption, and no weight will be given to farm inputs.

9.2.20 Which index in this example is '"correct"? If properly constructed, all three are "correct" in the sense that each addresses a particular user need. They are different simply because they serve different purposes. The general consumption index would give the best picture of how the drought was affecting the country as a whole. The fact that the price of farm inputs had fallen would not reflect the problem faced by subsistence farmers who had to find ways of providing food for their families and were unable to benefit from the fall in farm input prices. The monetary index would give the most relevant measure for the country as a whole of the change in prices of goods exchanged within the market. For the purposes of monetary policy the general consumption index would overstate the level of inflation but for the purposes of understanding the impact of the drought on the price of consumption it would not. The converse is true of the monetary index. The compensation index would not reflect the full impact of the drought on all households but it would reflect the impact of the drought on indexation households. The general consumption index would overstate the impact of the drought on indexation households and the monetary index would understate the impact; both would be biased if used in the context of indexation.

9.2.21 Each country has to make its own decision as to which of the three types of index is appropriate in its own circumstances. Countries with well developed price statistics systems could consider compiling all three types of index. They would need to educate users about their respective roles. Most countries will opt for one or possibly two types of index. In that situation national statistics institutes have to make a balanced decision as to which index (or indices) will be the most useful in meeting the country's needs.

treatment of subsistence households and subsistence consumption. If there are changes in the relative prices of the selected product groups, the choice of index type will affect the outcome. Each index will tell a different story concerning the impact of the drought on households, particularly subsistence households.

Construction of a "general consumption" index

9.2.22 To include subsistence households and consumption in this index it is necessary to construct appropriate consumption weights and to decide how subsistence consumption will be priced. We consider both aspects in turn.

9.2.23 The normal source for subsistence consumption weights will be a household budget survey or a survey of subsistence households. To measure subsistence consumption, households are asked to record the quantities consumed of own account goods. To obtain a value weight a "price" is applied to the product. Usually this will be the price of the product in a relevant market. Most countries with significant subsistence production will prepare estimates of the value of subsistence consumption classified by product. This will be prepared for use in poverty analysis and possibly also for use in compiling the national accounts. When preparing weights for a general consumption index these estimates of consumption should be combined with estimates of purchases of the same products by non-subsistence households to obtain the total consumption weight for each product. It is important to exclude weights for any market purchases of items used as inputs into subsistence production, for example fertilizer, tools and herbicides. These products are excluded but only in respect of households for which subsistence production is estimated. For all other households they are included in the weights and classified within recreational expenditure (COICOP 09.3.3.)[29]

9.2.24 An alternative estimation procedure for obtaining weights is to use the Commodity Flow Approach. This is a generalised approach which uses domestic production and import/export figures in the national accounts to adjust consumption expenditures which have been under- or over-reported in the Household Budget Survey (see Chapter 4). It can also be used to estimate own account production although it relies on survey estimates of total production, including own-

[29] For non-subsistence households, garden produce may be treated as a recreational outcome rather than the result of a production process, depending on the motivation and circumstances of production. Using this treatment, purchases such as tools or fertilizers are gardening or recreational expenses and not inputs into the production of food. For some households the line between subsistence production and recreational activity will be unclear. Statistical agencies should adopt practical rules based on national circumstances for making this distinction. For example, urban food production for own consumption may be treated as recreational and rural food production for own consumption may be treated as subsistence production.

account, so that conversion factors can be estimated and applied to HBS expenditure data.

9.2.25 The price of basic foodstuffs may vary, particularly between urban and rural areas. This will reflect availability, demand, transport costs and other factors. The most appropriate price to apply to subsistence consumption would be the price in a market near to where the subsistence consumption takes place. Typically this would include many rural areas. If a country collects basic foodstuff prices in both urban and rural areas, the most appropriate price would be an average of the rural prices weighted so as to reflect the distribution of subsistence agriculture. In practice a simple average of rural prices might provide a reliable estimate, particularly if the selection of rural outlets is roughly self-weighted.

9.2.26 Similar pricing considerations apply to the prices used when compiling the results of a household survey to estimate subsistence consumption. Price statisticians can assist the household survey statisticians with these estimates. If the price statistician is producing a general consumption index they should ensure that the prices used to value subsistence consumption are consistent with the prices used in construction of the price index.

Construction of a "monetary" index

9.2.27 One of the main challenges in including subsistence households in this index is to construct appropriate consumption weights. This is because this index uses purchases of inputs used in producing subsistence outputs as a proxy for subsistence consumption. Additional price information is only required for input items that are unique to subsistence households. If items are purchased by non-subsistence households and are already priced for CPI purposes, the latter price information can be used for the subsistence inputs component of the monetary index, such as spades, seeds etc.

9.2.28 The normal source of weights for inputs into subsistence production will be a household survey, such as a general household budget survey or a survey of subsistence households. When preparing weights for a monetary index these estimates of consumption should be combined with estimates of purchases of the same products by non-subsistence households to obtain the total consumption weight for each product. It is important to exclude weights for subsistence consumption which may have been prepared as part of the household survey. Subsistence consumption is excluded because the weight for inputs used in subsistence production is included in this index as a proxy for subsistence consumption and to include that consumption would involve double counting.

Construction of a "compensation" index

9.2.29 If it is decided to compile a 'compensation index' it is unnecessary to construct subsistence consumption weights and to decide how subsistence consumption would be priced because an index designed for the indexation of wages or benefits will generally exclude subsistence households from its scope.

Own account household services (excluding owner-occupier housing services)

9.2.30 Services produced by households include such things as the preparation of meals, the care of children, the sick and the elderly, cleaning and maintenance of dwellings and the transport of household members. Housing services are provided by the stock of owner-occupied dwellings.

9.2.31 The CPI Manual recommends that goods used as inputs into services produced within the household (e.g. cleaning agents, fuels or cooking ingredients) should be treated as consumption. It also recommends that the actual outputs are excluded from the scope of the CPI and that no attempt is made to impute expenditures to them. Home cooked meals are a service output produced within the household. The CPI Manual recommends against imputing expenditures in respect of these meals. Similarly it recommends against imputing expenditures to other services produced within the household such as when parents transport their children to school or care for a sick child. These treatments are consistent with the SNA. Although it may be conceptually more appropriate to regard the outputs of household production as consumption rather than the inputs, data in respect of the outputs of these areas of household production would require many assumptions and imputations. As a result they would be of little practical use and so are excluded from the CPI and the SNA production boundary as well.

9.2.32 It should be noted, however, that a long-term bias can result if households increase their purchases of services and decrease their production for own account consumption and this is not addressed in an updating of weights. For example, if households purchase more take-away or restaurant

food instead of preparing food for their own consumption, over time the relative expenditure on take-away and restaurant food will increase and the relative expenditure on food ingredients will decrease. If long-term labour costs increase more rapidly than basic food prices, there will be a long-term downwards bias to the index (and conversely if they increase less rapidly) unless the impact of this change in behaviour is reflected in a revision of the weights both for own account production associated purchases and other household purchases. This is because labour costs have a greater impact on take-away and restaurant food prices than on food ingredient prices. As noted above, although the household contributes labour when producing household services, this is not included in the index because of the problem of putting a price on household labour. Expenditure weights should be reviewed on a regular basis.

CHAPTER 9.3

Special Cases - Services

Introduction

9.3.1 This chapter covers a selection of the more important services in a CPI – health, education and public transport. The principles described can also be applied to other services. Housing, aspects of which can be considered as a flow of services, is dealt with separately in 9.1 because of the special issues relating to its treatment conceptually and to the associated measurement difficulties.

9.3.2 Chapter 10 of the CPI Manual provides comprehensive advice on the measurement of services including detailed guidance on the measurement of financial services, property insurance and telecommunications.

9.3.3 The ILO Resolution gives no specific guidance on the measurement of these services but it recommends that all kinds of goods and services consumed by the reference population should be included in a CPI. It is thus drafted on the implicit assumption that all these services should be included in the CPI.

Background

9.3.4 Services are a large, diverse and growing part of consumer spending. As Table 9.3.1 indicates, many consumption categories according to COICOP include elementary aggregates of service items.

9.3.5 COICOP includes the full range of services covered in the national accounts. In principle, all these should be included in a CPI compiled as a general economic indicator, but some countries choose to make some services out of scope for a CPI even if they are included in the national accounts. COICOP categories that are often excluded from the CPI are games of chance and financial intermediation services because they are not considered by some as consumption items. Illegal services and fines for violating laws are also often excluded from the scope, the former mainly for practical reasons and the latter because they are not part of Household Final Consumption Expenditure in the SNA.

9.3.6 Services present some conceptual and methodological difficulties for CPI compilers. The main feature that distinguishes services from goods is, of course, that they are not tangible. In addition,

Table 9.3.1 Distribution of elementary aggregates between services and goods according to COICOP

	COICOP	
Category	**Services**	**Goods**
01 Food and non-alcoholic beverages	0	11
02 Alcoholic beverages, tobacco and narcotics	0	5
03 Clothing and footwear	2	4
04 Housing, water, electricity, gas and other fuels	8	7
05 Furnishings, household equipment and routine household maintenance	3	9
06 Health	4	3
07 Transport	8	6
08 Communication	2	1
09 Recreation and culture	7	14
10 Education	5	0
11 Restaurants and hotels	3	0
12 Miscellaneous goods and services	11	4
TOTAL	**53**	**64**
TOTAL GOODS AND SERVICES	**117**	

many types of services are not available for price collectors to examine directly. In some service categories there may be a great variety in specific services. Service providers may tailor them to individuals to make them more suitable e.g. a doctor modifying a treatment for a particular patient. Services may be applied directly to consumers, as in health care, or to consumers' durable goods, as in the case of repairs, or supplied directly for consumers' use, as in the case of entertainment. Services may be bundled with goods, as with repair warranties for vehicles or mobile telephones.

9.3.7 As a result of these complications, difficulties can arise both in sampling and in price collection.

- *Sampling*. The "tight specification versus loose specification" debate can be acute for many services. It is generally advised to follow a loose specification when sampling and tight specification when pricing. A general specification is used when first establishing what will be priced in the outlet in order to allow the price collector to find something representative of what the selected service provider sells. Then, once the price collector and the respondent have settled on a particular item, a tight specification is used. At that point the price collector should describe the item in detail, noting any features that are likely to affect the price. Ideally the same price collector should return to visit the same respondent to collect all future prices. Clearly this will not always be possible, but having a good description of a tightly specified item should result in "like-to-like" price comparisons whenever possible and will help the most suitable replacement to be found should the original item be discontinued. The "Structured Product Descriptions" (SPDs)[30] used by the International Comparison Programme provide a useful tool for describing items within categories precisely and completely, and can be adapted for use with the CPI.

- *Prices*. For some service categories it can be difficult to obtain prices because there are either few or no clearly-defined or established outlets. Examples include domestic services such as in-home child care, maid services, and private protection services. For these the CPI can obtain expenditures from the household budget survey, but finding a stable sample of sellers from which to obtain prices may not feasible. This is particularly so where the people providing the service are part of the informal economy and are employed on a casual basis. In such cases the only approach available to the price statistician may be to impute a price or price change from some other item, elementary or higher aggregate. For instance, the pay rate of an office cleaner or a maid in a hotel may be used as a proxy for the cost of employing a maid in a private household.

9.3.8 Guidance on the construction of price indices for a selection of the more important services is given below.

Health, education and social protection services

9.3.9 In many countries, various government units or non-profit institutions serving households (NPISH) will sometimes finance and pay for the full or partial provision of a significant proportion of goods and services. Health, education, and social protection are often recognised as the sectors where these types of goods and services are typically produced.

9.3.10 The overall position is as follows:

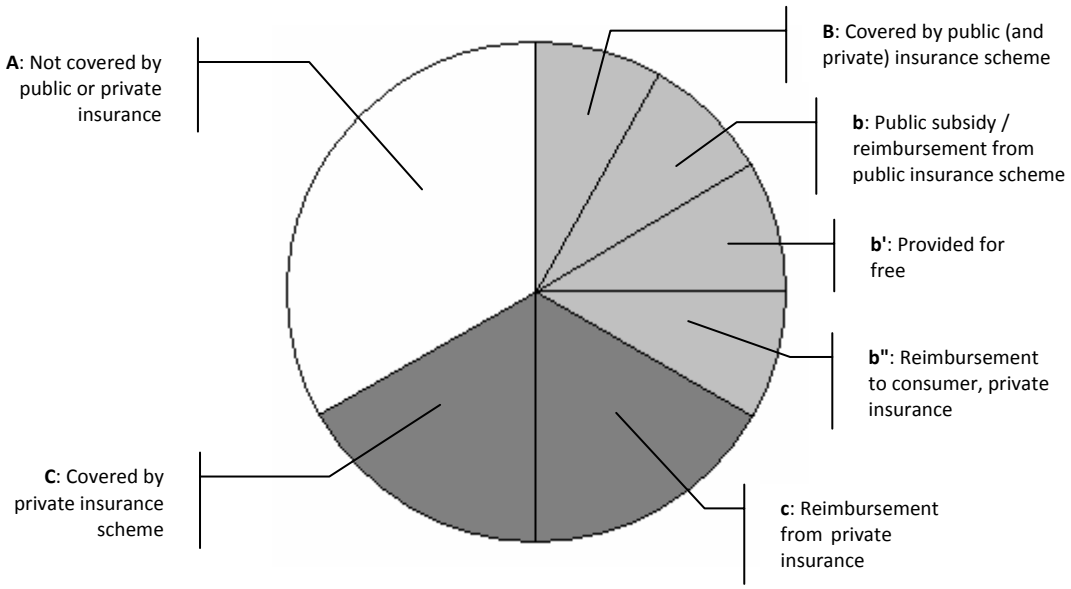
- Expenditure is included into the CPI only in regard to the households' expenditure on these services, i.e. payments that are made as a direct consequence of purchase of individual goods or services. These prices should be net of direct reimbursements. Reimbursements refer to payments to households by government units, social security administrations or non-profit institutions serving households (NPISHs) that are made as direct consequences of purchases of individually specified goods and services, initially paid for by household.

- Obligatory payments are excluded from the scope of the index (for example, employee's contributions to social security schemes). These are collected to finance social security schemes and these payments do not directly relate to provision of goods or services. Reimbursements that do not directly relate to goods or services are not in scope.

- Other payments or rebates to households by government units, social security administrations or NPISHs in the form of assistance to reduce household expenditure, such as housing allowances to tenants or payments due to sickness, disability, the care of elderly relatives or scholarships to students, are

30 http://siteresources.worldbank.org/ICPINT/Resources/ch5_Annex1.xls has an example of a Structured Product Description

Figure 9.3.1 Health, Education and Social Protection – total expenditure and the CPI coverage



Total expenditure (all sectors) = A+ (B+b+b'+b'') +(C+c).

Government and/or non-profit institutions' expenditure = b+b'

Private insurance sectors expenditure (claims by household sector) = b'' + c

Household sector's expenditure net of public subsidies, gross of private insurance claims (CPI Scope) = A+ (B+b'') + (C+c)

considered as social benefits in cash. They are treated as income transfers to households and do not constitute reimbursements

9.3.11 For the background we need to go back to national accounts conventions. Goods and services acquired by households and for which the government or NPISH provides a subsidy either through a full or partial reimbursement should be measured net of direct reimbursements. For example, individuals that are part of a particular socio-economic group may be eligible for a full or partial refund for dental care; if the refund covers the full cost of the dental service, then the expenditure weight would nil and no prices would need to be monitored for the purpose of the CPI.

9.3.12 Individual goods and services provided at no charge or at a subsidised price to individual households by governments or non-profit institutions are generally described as social transfers in kind and costs are included in government expenditures[31]. Examples could include, depending on the country, any or all of the following: food stamps, subsidised housing, prescription drugs, and job training programs. Clearly, these in kind transfers can contribute substantially to the standard of living of the individual households that receive them.

9.3.13 Depending on a particular country's circumstances it could be that the public authorities have decided to partly or fully finance the provision of certain goods and services. Regardless of the practice, those expenditures incurred by government or non-profit institutions to finance social transfers in kind are unambiguously outside the scope of a CPI (although it can be argued that it is desirable to take them into account when estimating a comprehensive and "true" cost-of-living index. However, when the consumer pays part of the cost associated with the provision of such goods and services, then this element is within scope of the CPI; although subsidised, this expenditure may account

[31] Looking at it another way, services provided free as social transfers could, in principle, be regarded as part of household consumption expenditure but with a zero price. Social transfers in kind consist of individual goods and services provided as transfers in kind to individual households by government units (including social security funds) and non-profit institutions serving households (NPISHs), whether purchased on the market or produced as non- market output by government units or NPISHs. The items included are: social security benefits, reimbursements; other social security benefits in kind; social assistance benefits in kind; transfers of individual non-market goods or services.

for a large part of a household's final monetary consumption expenditures. Take for example a subsidised rental unit for which the monthly cost of providing the rental service is $800 and where, after the government subsidy, the actual rent paid by the tenant is $500. While the $300 subsidy is excluded from the scope of the CPI, the rent of $500 paid by the tenant is a legitimate consumer expenditure that should be included in the CPI.

9.3.14 Users' expenditure should be included in order to properly reflect changes in prices in case governments and non-profit institutions decide to introduce charges for services that were previously provided at no charge, or vice versa.

9.3.15 To clarify the CPI coverage of the health, education and social protection sectors, Table 9.6.2 divides the total expenditure on the basis of who bears the cost.

9.3.16 Table 9.3.2 highlights possible combinations of payment and reimbursement systems. In practice the different mixes between publicly financed social security schemes, employee or worker financed social security schemes and social security schemes financed by individuals may be more complicated.

9.3.17 Thus, the subsidised nature of the health, education and social protection sectors is a challenge for price index compilation. The national index methodologies have to be built around the national social insurance system.

9.3.18 Note that the procedures used in the treatment of tariffs, as described in Section 9.3, are often applicable for pricing schemes encountered in health, education and social protection services.

9.3.19 Finally, it should be noted that to it is likely that detailed in-depth research will need to be undertaken to identify and measure newly introduced significant charges. Some of the goods and services in health, education and social protection are difficult to measure at constant quality. The social security systems can also cause complications. The CPI compiler is advised to keep in close contact with their policy colleagues to obtain the information which is necessary in order to make informed decisions about which charges should be included in the index and how they should be measured, and also to gain access to relevant sources of data.

Health services (doctors and dentists)

9.3.20 How to handle health services in the compilation of individual countries' CPIs will depend on the institutional arrangements for providing them. Government-provided free medical care is out of scope, but many countries adhere to some form of two-tier health care system whereby some health care services, often for a small fee, are provided by a private system that co-exists with the public system or where medical services are subsidised partially by the government but the consumer pays part. In both cases fees paid by the users are in scope. Employer-provided medical care is beyond the scope of the CPI - a transaction is not involved and it is treated in the national accounts as remuneration in kind.

9.3.21 Although health is a broad term, for the construction of an elementary aggregate in a CPI it generally refers to medical care provided by medical professionals, para-professionals or medical institutions.

9.3.22 COICOP divides the health care sector into classes according to type of medical care provider - doctors, hospitals, etc. This facilitates sampling, price collection and index construction. The goods and services covered by the Health category (COICOP category 6) consist of the following sub-categories.

06.1 Medical products, appliances and equipment

06.1.1 Pharmaceutical products

06.1.2/3 Other medical products, therapeutic appliances and equipment

06.2 Out-patient services

06.2.1-3 Medical and paramedical services

06.2.2 Dental services

06.3 Hospital services

06.3.0 Hospital services

9.3.23 In addition, it also includes health services purchased from school and university health centres.

9.3.24 The weights are the amounts consumers spend on each type of provider. In countries where the government does provide a substantial portion of medical care free of charge, the relative importance of medical care in the CPI is less than its expenditure share as measured by the national accounts.

9.3.25 Some critics have noted that the COICOP categories are activity classes — not classes according to consumers' purposes. These critics state a preference for categorisation by types of medical condition and are of the view that the CPI should measure the cost of treating a disease or of obtaining a fixed outcome after treatment rather

than the medical service or treatment itself, which, in their terms, is an input. But it should be noted that the "medical condition approach," which would define elementary aggregates for categories of medical conditions, is not sufficiently developed to be recommended at this time. The recommended procedures are as follows.

Sampling

9.3.26 The general CPI practice is to select samples of providers within each COICOP category (doctors in Medical Services, dentists in Dental Services, etc.), and then choose one or more service items for each sampled provider. The principle of "loose specification when sampling and tight specification when pricing" is followed. When first visiting a doctor or other medical provider, the price collector should find out what services are provided or medical procedures are performed and select a representative sample with guidance from the provider. The price collector should describe them as completely as possible, and then continue pricing them as long as possible or until they are no longer part of the sample. One approach to the initial sample selection of services or medical procedures is for the price collector to ask the medical practitioner or dentist what was provided recently to a "typical" patient with a representative medical condition or to ask the respondent to describe a simple service they recently performed. When returning to obtain future prices, the price collector should collect the price for that identical service, even if the doctor or dentist has not performed it recently. If, however, the respondent has not performed it for a year or says that he will no longer perform that particular procedure, the price collector should find a replacement procedure, preferably for the same purpose. Headquarters should then judge if it can be treated as a comparable item. The need to price many types of medical services from the same doctor reduces where it is known that price movements among various medical services move more or less closely together.

Pricing

9.3.27 There are two approaches to pricing. The traditional *input approach* treats medical items as just consumption items, without regard to their effectiveness in preventing, curing or ameliorating an illness or injury. The approach prices particular medical items, such as an annual check-up by a doctor, or a particular surgical procedure, such as an operation in a hospital or clinic, and follows the cost over time.

9.3.28 The alternative approach, the *treatment approach*, is a partial response to increasing criticism that the input approach ignores medical advances and that it also loses sight of the fact that the patient, unarmed with medical knowledge, generally looks to buy a cure to a medical condition rather than a particular course of treatment. Under the *treatment approach* the price statistician or collector firsts selects a specific medical problem by selecting a disease or injury for which a patient recently received treatment and then follows the price of treating that disease or injury regardless of medical procedures or medicines used. For example, if treating the disease or injury initially requires five visits to the doctor, the CPI price is the cost of five visits. However, if subsequently the doctor reports that he or she is now using a new way of treating the condition that requires only two visits, then from that point the cost of two visits is included in the CPI.

9.3.29 Services in health are included into the CPI only in respect of household expenditure on these services, i.e. the payments that are made as a direct consequence of purchase of individual services. It follows that these prices, whether subsidised or not, should be net of direct reimbursements. Obligatory payments, such as employees' contributions to social security schemes, are out of the scope of a CPI. These are collected to finance social security schemes and do not directly relate to provision of goods or services. Reimbursements that do not directly relate to goods or services, i.e. where the recipient has the opportunity to spend the money on something unrelated to the treatment which is the subject of the reimbursement, are also excluded.

9.3.30 Both approaches – the input approach and the treatment approach – may involve "quality adjusting" the prices where a change of treatment or course of medication results in a change in outcome. For instance, if in the above example the reduction to two visits to the doctor is associated with a shorter course of treatment and with the patient being in less pain and suffering fewer adverse side-effects, then the "quality" adjusted price should see a steeper price reduction due to the better treatment.

Coverage of Medical Insurance

9.3.31 The existence of medical insurance confuses the situation further. Some consumers buy medical care directly from medical care providers, while others buy medical insurance that pays for some or all of their medical care. It is, perhaps, useful to review exactly what kind of product the consumer is actually buying. Medical insurance may be considered a way of prepaying for likely future medical expenses, a way of reducing the risk of catastrophic expenses (i.e. giving peace of mind), and a way of reducing the total expected cost of

medical care from insurance companies having the market power that individual consumers lack. The view taken about what is being purchased, which clearly may be a mixture of the above, has implications for measurement. For example, the use of net premiums for weights (see below) fits better, conceptually, with insurance being purchased for peace of mind.

9.3.32 As in the case with health care, in many countries the government provides health insurance. This is generally out of scope for the CPI regardless of how the government funds it and is excluded from the CPI weights and pricing samples. Only the cost of insurance paid directly by the consumer is in scope for the CPI.

9.3.33 In constructing expenditure weights care should be taken to avoid the double counting of expenditures. Consumers may pay insurance premiums and then the patient either pays the costs (i.e. the medical bills) which the insurance company then reimburses either in full or partially, or the insurance company directly reimburses the providers (e.g. the doctor or the hospital).

9.3.34 In its discussion of property insurance the CPI Manual identifies "three plausible alternative treatments" of insurance which can similarly be applied to health insurance.

- Gross insurance premiums/net medical expenditures
- Net insurance premiums/gross medical expenditures
- Gross premiums/gross expenditures.

9.3.35 If applied to health insurance, the first of these alternatives results in a relatively large weight for medical insurance and small weights for medical care categories. The second reverses this. The third double counts consumer spending and should not be used.

9.3.36 The gross premiums method is out of favour with many CPI experts but is supported by a number of economists. Under this method there is an elementary aggregate for health insurance with a weight that is based on consumers' total expenditure on health insurance premiums during the reference period. The expenditure weights of the other medical care elementary aggregates (those for doctors, hospitals, etc.) must be reduced by the amount of insurance payments consumers received in the same period. These elementary aggregates represent what consumers pay "out of their own pocket" for medical care. The CPI prices for these elementary aggregates are what providers receive from consumers—not from insurance companies. It can be argued that, compared with the net premium approach, the use of gross premiums is more consistent with the concept of pre-paying for likely future medical expenses and is therefore better able to cope with a situation where some consumers purchase medical services directly and others purchase the same medical services through an insurance company.

9.3.37 The primary difficulty with this method is constructing a price relative for gross premiums, which ideally would be a measure of the change in the premiums of a sample of constant-quality insurance policies. However, in reality insurance companies change the detail of their policies from year to year, with new rules and requirements and changes in what they cover; some of this is being in response to the appearance of new medical techniques. It is extremely difficult to track and adjust for these changes, but without doing so a premiums index is likely to be biased upward.

9.3.38 For the reason stated above, the "net" premiums method is the most common approach implemented in a CPI. Here the CPI weight of the insurance elementary aggregate is gross premiums paid minus reimbursements paid out by insurers. The CPI weight comprises the insurance companies' expenses and their profit, which will be very much smaller than the gross turnover. The net approach allocates expenditures for health insurance premiums that consumers report in the Household Budget Survey to the other medical care elementary aggregates. This is usually done using insurance industry data on the insurance companies' income received from premiums and the companies' payments to doctors, hospitals, clinics, drug stores and any other providers. To do this, the index compiler computes the share of payments to each type of provider and allocates medical insurance premiums to other medical care elementary aggregates in proportion to these shares. Health insurance companies retain a small portion of the premiums not paid out as benefits to cover overheads and profits. The CPI can treat this as a separate elementary aggregate for health insurance or just allocate it to the medical care categories using the same proportions. See Table 9.3.2.

9.3.39 The CPI price movement over time can be the same as in the direct approach: over a long period the change in the premiums of a sample of insurance policies can be used as a proxy for a measure of the change in the insurance companies' overheads and profit per capita, i.e. the change in the cost of providing the insurance service.

Table 9.3.2 CPI Weights: medical insurance and medical care elementary aggregates

	Total	Health Insurance premiums	Hospitals	Doctors	Drugs
Budget Survey data = CPI weights with gross insurance	1800	1000	300	300	200
Insurance industry data	900		500	300	100
CPI weights with net insurance	1800	100	800	600	300
CPI weights with no insurance	1800	0	856	633	311

9.3.40 The price relative for the net insurance premiums aggregate can be developed in the same way as under the gross premiums method, using a sample of insurance policies. The problem of holding the policies constant over time remains, of course, but this is less troublesome because the weight is much smaller. Alternatively, a measure of the change in the insurance companies' net earnings (premiums less payouts) can be used. This may be volatile and net earnings could actually be negative in particular years, and so statistical offices who use this approach often take an average figure over a number of years. In addition, such a measure requires data that insurance companies may be reluctant to provide.

9.3.41 It is important that the CPI reflects the prices that insurance companies pay as well as those prices that self-paying consumers pay "out of pocket", particularly so given the fact that there can be significant price differentials. Providers, however, may be reluctant to reveal or have difficulties in calculating what the insurance companies actually paid, so it may be difficult to collect these prices, and it is rare for CPIs to use them.

Weights

9.3.42 In the first row of the example in Table 9.3.2, the Household Budget Survey reports that consumers spent (from their own pockets - government-provided benefits are not in scope) a total of $1800 on medical care, $1000 on insurance and the rest on direct payments to medical providers. Under a gross premiums approach, these are the weights for insurance and medical care categories, i.e. standard CPI weights: expenditures reported in the HBS of what consumers paid out of their own pockets.

9.3.43 To obtain weights for a net premiums approach more data are required. The second row has the insurance industry's spending on medical care - the insurance companies spent $900 in benefits and retained $100 to cover their costs and their profits. Using this industry data to construct CPI weights yields a small aggregate for net insurance premiums, as shown in the third row. Alternatively, the CPI could allocate all insurance premiums to the medical care aggregates, as in the last row.

Education

9.3.44 The scope of the CPI is limited to payments actually made by consumers. Consequently, fully publicly-funded education is out of scope of the CPI. However, there are usually some minor ancillary fees for materials or services, such as pens and paper, and sports activities that students must pay for and these should be included in the index. Out-of-pocket educational expenses for tuition and related costs are treated as standard consumption items. In these circumstances the CPI weight for education is the out-of-pocket expenditures as reported in the Household Budget Survey.

9.3.45 The goods and services included in the Education category (COICOP category 10) cover educational services only. As well as the main channels of education, this includes:

- Education by radio or television broadcasting
- Educational programmes, generally for adults, which do not require any special prior instruction, in particular vocational training and cultural development
- Literacy programmes for students too old for primary school including out-of-school secondary education for adults and young people and out-of school post-secondary non-tertiary education for adults and young people.

9.3.46 It does not include:

- Expenditures on educational materials, such as books (09.5.1) and stationery (09.5.4), or education support services, such as health care services (06), transport services (07.3), catering services (11.1.2) and accommodation services (11.2.0).

- Driving lessons (07.2.4); recreational training courses such as sport or bridge lessons given by independent teachers (09.4.1).

9.3.47 The same principles apply as in health services. The compiler is advised to refer to COICOP for guidance.

9.3.48 In many countries, the government partially subsidises education, particularly higher education, and students pay a portion of the cost of their education and this portion is in the CPI's scope. The tuition fees faced by students are not always the full cost of education, and in these cases the CPI weight should not and does not represent the full cost of providing education to the population, just the cost to the individual of acquiring an education. Changes to the amount of the government subsidy can lead to changes in the tuition charged to students and the index should show any resulting change in the fees. If a student goes to a private school, where there is no subsidy, the total advertised price *P* for fees should be reflected in the CPI weights and in the price paid, as this is what it costs the household to educate the student. In the case of a government subsidy, let *s* be the share of this total advertised price which is actually borne by the household (i.e. the household is presented with a bill showing a net price of *sP*), then the appropriate price for the CPI and for the construction of weights is *sP*. In this way, the proportion of the cost borne by the household will feed through into the calculation of the CPI, i.e. the CPI will reflect the actual fees paid by the household which, in this case, will be less than the basic advertised price.

Pricing – tuition fees

9.3.49 The typical item to be priced will be the cost of a term or semester at a sample of schools. A school term is usually longer than one month, which is the calculation frequency for most CPIs. Standard practice in this case is to collect prices only in months when the terms begin, and use that same price in the intervening months. The pricing months can vary depending on the country or the school. For example, if a school has two semesters, one starting in September and the other in January, then tuition fees should be priced in these months only. In other months the price is "carried forward" i.e. the same price is used for the remaining months of the term. The index and the associated inflation rate may display step changes, changing only in the months when the terms begin.

Scholarships and other forms of discounting

9.3.50 Schools and universities often reduce the tuition for some students. Tuition fee reductions offered in exchange for work, e.g. teaching assistants, or that require participation in sports teams should not be reflected in the index as they are a form of income.

9.3.51 The treatment in the CPI of scholarships to particularly talented students or tuition assistance in the form of financial aid to students from certain socio-economic backgrounds such as low-income households depends on the method of payment:

- Those that are paid directly to students to assist them in bearing the cost of the full fee but which the students can use, if they wish, to finance something else, are transfer payments that the CPI should not reflect.
- Where the scholarship or subsidy results in students being subject to reduced fees, i.e. they are billed for a reduced amount, it is the reduced fee which should be priced for the CPI.

Weights

9.3.52 Weights for educational services can be difficult to obtain. Information from the HBS can be unreliable and National Accounts principles only allocate the costs incurred by households as a part of household final consumption expenditure. The level of detail in accounting is often varied and may not allow the division of the costs to the level of detail required for index compilation. Therefore a better source of detailed weighting information may be the public institutions in charge of the educational schemes.

Pricing

9.3.53 The recommended approach is to use "student profiles" to price the cost of education for a selection of typical students who are chosen to reflect different levels of fees and base-weighted to reflect their distribution in the particular educational institute which is being priced. Where the fee structure is straightforward it may be sufficient to simply collect prices for the posted or advertised tuition fees directly from the institution or its website. Any discounted tuition fees can be ignored where it is known or can be assumed that they change at the same rate as the full fees and that the proportion of students benefiting from them remains constant over time. However, any assumptions would need to be checked on a regular basis and there are inherent dangers of introducing an element of bias in the index if differential changes in fee structures or changes in the student population are missed. The approach should be used with care. Similarly, the use of average revenue (total tuition fees divided by the number of students) is not an appropriate way to price tuition fees which

include price differentials, as changes in the composition of the students attending the college can affect the average fee even when no price change takes place.

9.3.54 In some countries it is common for students to travel outside the country for their higher education. In such countries, expenditures paid by nationals for tuition at foreign institutions may be deemed to be in scope for the national CPI depending on the geographical coverage of the index and whether expenditure was incurred in the domestic territory of the country of residence or abroad. Where such costs are included, changes in the education or tuition index from the destination countries can be used to construct the price relatives for the education component, adjusted to the national currency using the exchange rate applying in the reference month.

Transport

Public Transportation

9.3.55 Again the same sort of algebra applies as in tuition fees. Let *P* be the total cost of providing a trip from *A* to *B* and let *Q* be the number of trips carried by the transport system from *A* to *B* during the period under consideration. Suppose the household sector pays only *sP* of this price then the household price is *sP* and the quantity is *Q*. Obtaining the prices normally requires sampling and will need to take into account complex fare structures.

9.3.56 The index for airline and other public transport services should use the prices of a sample of specific trips rather than revenue per kilometre or per passenger-kilometre. If the CPI has strata for different geographic areas, which is typical in large countries, points of origin - airports, train stations, motor coach stops etc., should be chosen in each area and trips selected within origins or destinations in those areas. There are generally multiple classes of service. Transport fares may vary by day of the week and time of day as a result of demand variation, so the selected trips should reflect this variety but hold these variables constant.

9.3.57 Airlines particularly, but other transport modes as well, often practise some form of price discrimination so that different groups of travellers will be charged different fares or prices for essentially the same service. Examples are special discount fares for students or retired people, or trips booked for weekend departure or return, and a 30-day advance booking. Since these vary frequently, CPIs usually ignore minor changes in the requirements for a discount fare.

9.3.58 The recommended approach to differential and complex fare structures that is most likely to ensure like-for-like comparisons is to price the cost of a journey on a particular day of the month (e.g. the fourth Tuesday) between two points, pricing a ticket for transportation purchased at some previous time (say four weeks earlier, the fourth Tuesday of the previous month). This should be done for various fare classes, for example a full fare economy and a typical discounted economy fare, which may include travel restrictions such as for a stated date and time and not being refundable. Sometimes prices can be downloaded by staff at Headquarters from reservation systems available on the internet.

9.3.59 Changes in schedules can cause price changes. For example, an airline might cancel its noon flight, forcing passengers to take the evening flight, which is priced higher because that is a time of peak demand, unless a competitor airline can be found. If the CPI was following the price of the noon flight, it must now use the evening flight, if the customer has no choice but to use it, or use a noon flight available from an alternative airline. The replacement journey should be treated as comparable and the full price change should be reflected in the index, if it is assumed that there has been no change in the quality of the service being provided. But the latter might be a bold assumption. For instance, if an evening flight is inconvenient because it means travelling the day before and staying in a hotel in order to attend a morning appointment such as a visit to a hospital. In the latter case the noon flight might best be treated as a missing item.

Private Transportation

9.3.60 Private Transportation services in practice are services associated with motor vehicles, although in principle they could cover other modes of transport including by air and by water. They include: repair services; various fees; vehicle leasing, rental or hire. An attribute common to most of these services is that charges can vary depending on the model and year of the vehicle. It is desirable to update the model year through the use of some "model changeover" practice. One way to do this is to specify the age of the vehicle, e.g. pricing a brake repair or an oil and lubrication for a 3-year old Ford Taurus. This means that in 2008 the CPI prices the service of a 2005 Ford Taurus; in 2009, a 2006 model, etc. If the vehicle model associated with the observation is discontinued, e.g. if Ford discontinues the Taurus model then an appropriate replacement needs to be found.

CHAPTER 9.4

Special Cases - Tariffs

Introduction

9.4.1 The topic of tariffs is covered in paragraph 6.21 of the CPI Manual in the context of the treatment of variable pricing policies dependent on demand, and in paragraph 9.14 in the context of the assignment of weights. Paragraph 6.21 states the principle that "price collection should be made consistently over time and in a way that represents consumer purchasing patterns" and that the selection of representative items should "represent consumer behaviour" and "be weighted by consumer spending patterns". Paragraph 9.14 states that in the construction of elementary aggregates, which do not normally involve weights, "a special case occurs in the case of tariff prices" where "it is appropriate to assign weights to the different tariffs or prices in order to calculate the price index for the elementary aggregate". By way of an illustrative example, paragraphs 10.91 to 10.116 of the Manual then discuss the subject of tariffs in some detail in the context of the construction of price indices for telephone services.

9.4.2 The ILO Resolution makes no explicit reference to tariffs, but paragraph 58 states that "for goods and services where the prices paid are determined by combinations of subscription fees and piece rates (e.g. telecommunications) care must be taken to ensure that a representative range of price offers are observed" and that "care must also be taken that prices charged to different types of consumers are observed".

Background

9.4.3 In paragraph 9.14 of the CPI Manual a tariff is defined as a list of prices for a particular kind of good or service supplied under different terms and conditions. A similar but more detailed and possibly more helpful definition is provided in Article 2 of Regulation (EC) No 2646/98 of the Commission of the European Communities for the purpose of the European Harmonised Index of Consumer Prices (HICP). It states that "a tariff is a list of pre-established prices and conditions for the purchase and consumption of one and the same good or service, or of similar goods and services, that has been centrally fixed by the supplier, by the government, or by agreement to exert influence on the consumption patterns by means of appropriately differentiated prices and conditions according to characteristics of consumers, the level, the structure or the timing of the consumption.". The article goes on to define a tariff price, which is "a price within a tariff that applies to a component element or unit of consumption of the good or service in question." At its most basic, a tariff consists of a list of prices based on detailed specifications of the services that are priced individually but can only be bought as part of the package.

9.4.4 Economic theory recognises different types of price-discriminating behaviour on the part of sellers. Consequently, there may exist in the market many tariff pricing schemes. Some of the more common variants that are present in the market and which will be discussed in this section of the chapter are as follows:

- **Peak-load pricing** (also known as "congestion" pricing). This occurs when producers charge higher fees during periods of greater demand, usually because of the higher costs of production caused by capacity constraints. Peak-load pricing thus helps in balancing capacity usage over a period, which decreases the need for firms to invest in costly infrastructure expansions. Such pricing practices are often found in the areas of toll roads and bridges, ferry services, electricity, and long distance telephone calls.
- **Two-part tariffs**. These occur when consumers are charged both an entry (or lump-sum) fee and a per unit charge. In other words, a fee is charged up front for the right to use (or buy) the product and an additional fee is charged for each unit that the household consumes. Examples where two-part tariff pricing is often applied are:
    - Amusement parks that charge an entry fee in addition to a fee for each ride.
    - "Membership" discount schemes or shopping clubs that require the purchase of a membership card to access the point-of-

sale and then the consumer pays for his or her purchases at a lower than otherwise price. These should be covered in a CPI. They are not the same as discounts that are restricted to particular groups and which are generally ignored in a CPI as they do not apply to all consumers. The latter are covered in Chapter 6.

- Landline telephone services where there is sometimes a fee to use the service ('line rental') and also a fee per call. The line rental covers the cost of providing the service and the "per minute" or metered charge, covers the cost of placing the call on the network.
- Taxi fares where a variable fare based on distanced travelled is added to the base "fixed" initial charge which is not dependent on mileage.

- **Block pricing** is when prices vary according to the volume consumed. Electric utilities, for example, often charge a per KWh price up to X units consumed and then charge a different price for the remaining units.
- **Special group discounts**. This is where members of certain segments of the population such as students and seniors may be charged a lower price for the good or service compared to the general population. Bus fares and hair cuts are good examples of services where these group discounts are applied.

9.4.5 In some countries, private and public firms have come to rely increasingly on tariff-type pricing as a tool for generating additional revenues or for public policy purposes. For example, publicly administered electric or water utilities may charge a lower tariff for the first units of electricity consumed up to a certain level (the first block), followed by a higher tariff for subsequent units consumed (the second block). Such an increasing block tariff strategy is often used, it is argued, to promote better and greater access by lower-income households to what is considered a vital service. Private sellers can often increase their profits by charging a higher price for a product to some consumers and a lower price to others if it can successfully segment its customer-base.

9.4.6 Clearly, tariff-type pricing schemes can be applied to a wide range of products. The extent of the practice will vary according to the country. In cases such as electricity, the weight of the component can be relatively high so it is important to measure accurately the price change for such commodities.

The main measurement issues

9.4.7 Tariff-type pricing schemes are used particularly for services and as such suffer from a number of price-index problems associated with services.

- Charges for services can be subject to such complex pricing schedules that it is difficult to select the appropriate prices for inclusion in the construction of the price index.
- Identification or specification of individual products or units of consumption themselves can be difficult, particularly when they are offered as bundled packages consisting of several types of micro-expenditure that may be priced separately but are typically only available as a part of a package.
- Services are often provided under long term contractual arrangements and these may include different types of "customer loyalty" rebates, clauses for the minimum duration of contracts, surcharges for the provision of services not foreseen in the contract, etc. Loyalty rebates or coupons are usually ignored due to difficulties of measurement (see Chapter 6).
- There are often difficulties in accounting for substitution between different providers of the same type of service, and in accounting for quality differences in the services provided.
- There can also be difficulties in accounting for customers moving under their own volition from one tariff to another under the same service provider. For instance, when a mobile telephone company offers a number of different pricing packages targeted at different patterns of usage, current customers may undertake periodic reviews during which they may decide to move to a more advantageous tariff for their level of usage.

Treatment of tariffs and the information requirement

9.4.8 Although there is no generally agreed approach about the exact treatment of tariffs within the framework of the CPI, the HICP regulation mentioned in paragraph 9.4.3, although developed for the EU, does offer some general and reasonable guidelines which can be applied to the national CPIs of other countries.

9.4.9 According to this regulation, the basic information requirement for a tariff should include "all tariff prices and weights which reflect the structure of the consumption of the good or service according to the characteristics of the consumers, the level, the structure or the timing of the consumption".

Price measurement methods

9.4.10 There are four basic approaches to tariff pricing - matched samples, unit values, customer profiles, and the sample of bills approach.

Matched Samples

9.4.11 *Matched samples* are where a full tariff list or an element of the tariff structure is treated as a "product specification" and re-priced in subsequent periods. This mirrors the traditional CPI methodology of matched pairs. The simplest form of traditional matching methodology would be to take the tariff price lists of some major companies and follow the changes in the entire pricing scheme, preferably with accurate weighting information for the different elements of the price list. This option may be feasible in markets of limited competition where the pricing structures should be quite stable. There are practical challenges associated with ensuring that exactly the same product specification is priced each month, i.e. that the matched pairs methodology is adhered to. There is usually limited data about the customer base. In practice the service to be priced using a full price list usually also has to be priced in a rather simple manner without too much differentiation on the basis of customers' characteristics, i.e. for the sake of simplicity some variations in tariff are sometimes ignored.

9.4.12 Another version of matching methodology is to select some elements of a tariff as "representative items" and re-price them in subsequent periods. For each representative item, detailed specifications combined with information supplied by the provider, are constructed. For instance, for air fares this could be for each airline carrier, a non-refundable and non-changeable airline fare from one pre-specified location to another, with pre-determined outbound and inbound dates chosen by time of day and day of week, including all surcharges).

9.4.13 The representative tariff element has the advantage that it can be applied to different service providers, at least in principle. It becomes possible to incorporate new service providers into the index without significant difficulties. However, the choice of only a few items as representative may limit the validity of the approach. Neither of the matching approaches is suitable for situations where there are major changes in the structures of tariffs. The matched sample methodology cannot usually be applied where the structures of tariffs regularly change.

Unit Values

9.4.14 The *unit-value approach*, where the overall average price of one unit, for example of electricity, for customers of a particular supplier is used for monitoring prices, instead of following individual elements of the tariff. The contents of the tariff-based service are homogeneous (e.g. KwH of electricity) and the method should be used only in such cases. The unit value is calculated using overall revenue and quantity data at a higher level that does not distinguish between different tariffs or customers. It attributes all the differences between different packages to price alone i.e. quality differences between different pricing approaches are assumed to be zero or insignificant. This may not be the case where, for example, the reliability of continuity of supply varies between suppliers. A particular advantage of this approach is that it can be easier to compute. But because of this mixing of quality and quantity, unit value indices are generally not considered ideal for constructing CPIs and are best avoided unless it can be proven that their weaknesses have no significant numerical impact.

Customer Profiles

9.4.15 *Pre-specified consumer profiles*. The idea of consumer profiles is to define the product independently of a single producer's or supplier's tariff structure. Instead, a more general formulation of the consumer's behaviour is constructed based on information (for example sales information provided by the industry as a whole) which can be used to define a range of typical consumers, irrespective of supplier. Different suppliers' services are priced through these typical consumers. A unit value price is calculated for each consumer profile and then this unit value is recalculated over time. The advantage of this approach is that it does not require an actual sample of bills, only the details of the different tariffs and some information on usage by "typical" customers. Also the price statistician could potentially define consumer profiles by class of household, e.g. prices for the poor versus the well off could be computed.

Sample of Bills Approach

9.4.16 The *sample of bills approach*. This is a more refined version of the customer profile approach where a level of service activity from an actual

sample of customers is priced each month rather than defining profiles representative of the average monthly activities of a range of customers (see above). This can be done, for example, by selecting a sample of customers from each category of customer, the latter being chosen to reflect the structures of the tariffs of the corresponding service providers. For instance, a sample of customers and their bills might be drawn from low, medium and high volume consumers of the product. The resulting index measures the cost of the current billing period's consumption (normally over a month or a quarter) at prices charged in the index period compared with prices charged in the base period. The sample of bills approach has a number of differences compared with the customer profile approach, most particularly:

- It takes into account in-year variations in consumption, for example, a greater volume of international telephone calls during public holidays and festivals.
- It reflects actual customer behaviour by reference to bills.
- It detects price changes not associated with tariff changes, such as reduced unit charges when a minimum threshold of consumption is reached.

9.4.17 It should be noted that there can be an inherent time-lag due to bills being issued after the index for the relevant time period has been compiled.

9.4.18 In each of the above approaches the resulting calculation should be based on prices and weights which reflect the structure of the consumption of the goods or services according to the pre-determined characteristics of the consumers and the level, the structure or the timing of the consumption. The corresponding checklist of price-relevant characteristics for tariff-based expenditures may include:

- The time-pattern of use of the service. The patterns of use may be measured over one day, one week or even one year.
- The volume of use of the service, for example where pricing schemes differentiate between small and large customers.
- The past behaviour of the customer. Particularly

Table 9.4.1 Matched Models: Landline Telephones

	Expenditure weights	Tariff (unit price $): base period	Tariff (unit price $): period t	Change in tariff price (% in brackets)
National calls				
Local	50			
Peak	30	1.20	1.30	+0.10 (8.3%)
Off-peak	20	0.80	0.80	0.0 (0.0%)
Long-distance	20			
Peak	5	2.10	2.50	+0.40 (19.0%)
Off-peak	15	0.90	1.10	+0.20 (22.2%)
International calls	30			
To Cape Town (service provider A)	10	3.50	3.50	0.0 (0.0%)
To Singapore (service provider B)	10	4.20	4.40	+0.20 (4.8%)
To Washington (service provider C)	10	3.90	5.10	+1.20 (30.8%)
Index (weighted geometric mean)	100	1.9200 (say)	2.1400	+0.18 (9.4%)

in insurance services where previous claims or medical histories may impact on the price paid.

- The expected future behaviour of a group of customers, leading to price differentiation between, for example, males and females or for different socio-economic groups. This again is particularly prevalent in insurance services where companies analyse claims information by personal characteristics.
- Income-dependent prices, most prevalent in public-sector tariff structures.

9.4.19 The bundling of different services, where a supplier might provide, for example, a mobile telephone plus free calls at certain off-peak times, or telephone and on-line computer services, needs to be taken into account in sampling procedures where such practices are common.

9.4.20 Clearly there are numerous combinations of the above factors that can be used to create different tariff structures and the structure of tariffs can undergo regular change. The price statistician will need to thoroughly research the topic and monitor the market to ensure that all relevant price differentials are picked up.

Illustrative examples

9.4.21 Illustrative examples of the different methods of incorporating tariff prices in a CPI follow. Note that the issue of quality adjustment is dealt with separately in the next section.

Matched samples

9.4.22 The illustrative example in Table 9.4.1 is based on telecommunications services.

9.4.23 The simplest form of matched models methodology is to take the tariff price lists of some major companies and follow the changes in the entire pricing scheme, incorporating weighting information for the different tariff elements. Where there are many service providers or many tariff elements it may be more feasible to select some elements of a tariff as "representative items" and re-price these items in subsequent periods although care will need to be taken to ensure that a representative sample is drawn. In the following example (Table 9.4.1), for illustrative purposes, there is just one service provider for national calls and three for international calls. It is assumed that in the base period the index value is 1.9200.

Unit-values

9.4.24 Where the quality of the service is homogeneous between providers the unit value approach can be applied instead of matched models with the advantage that it is generally less resource intensive. The unit value is calculated using revenue and quantity data at a higher level. For example, in telecommunications services the unit price for national long-distance calls is derived as the total revenue received from such calls, divided by the number of call-minutes. The advantage of the unit value approach is that since there is no sampling, the coverage of the services is complete and there is no need to specify representative items or different user categories. On the other hand, compilation of unit values typically requires close collaboration with the service providers. The price statistician will need to persuade the latter of the importance of providing this commercially sensitive information on a confidential basis. Assurances will need to be given that the information will only be used for compiling the CPI, will be kept secure and will not be disclosed to a third party. Note that stratification continues to be important, for instance by whether a call is local or long-distance and made off-peak or at peak times. Effective stratification is particularly critical in the compilation process if the effect of mixing quality and quantity is to be minimised.

Consumer profiles

9.4.25 For marketing purposes, companies often classify their customers on the basis of their consumption habits. The following example (Table 9.4.2) shows a typical range of representative consumer profiles for mobile telephones. Information on different consumer profiles may be obtained from service providers that use consumer profiling when planning their product pricing strategies. This type of information should generally be more readily available as it is less sensitive than actual revenue data. It can provide data for the unit value approach or for detailed weights in the matching methodology. National regulatory authorities may also be able to provide detailed customer use profiles on a confidential basis.

9.4.26 The use of customer profiles is quite straightforward in principle. Once the profiles have been identified, each service plan selected for pricing is priced and re-priced based on the (fictional) bills that these virtual customers would receive. Costs to each customer group can be estimated with reference to several plans using sales information to determine the relative importance of the different plans on offer and the corresponding consumer groups being targeted. The overall index is

Table 9.4.2 Consumer Profiles: Mobile Telephones

Specification	Unit	Low usage customer	Medium usage customer	High usage customer
Total usage (per billing period) excluding text messages	Minutes	14	24	59
Calls				
Within same mobile network				
Peak	Number*	5 (35)	10 (35)	15 (40)
Off-peak	Number*	10 (55)	10 (65)	20 (80)
To different mobile network				
Peak	Number*	0 (0)	5 (20)	15 (25)
Off-peak	Number*	5 (20)	10 (30)	20 (40)
To landline				
Peak	Number*	0 (0)	0 (0)	5 (20)
Off-peak	Number*	5 (3)	5 (8)	5 (13)
Other services				
Text messages	Number*	5 (20)	10 (25)	30 (35)

* in brackets, average call length in seconds

then derived in the usual way by weighting together the average unit costs for these user profiles according to the relative importance of each consumer profile (representing a category of consumer) in expenditure terms.

9.4.27 A potential problem with this method is that if a new plan is introduced in the following year that is different and cheaper, but the old plan continues to be priced, then the fall in unit value prices will not be reflected in the index. A new plan could offer higher or lower average prices and the CPI would miss the price change going from year one to year two.

The sample of bills approach

9.4.28 This is in principle very similar to the consumer profiles approach but may be more difficult to apply in practice given the fact that it is more data intensive, requiring access to more detailed personal and commercially sensitive information.

Quality adjustment

9.4.29 Dealing with changes in quality can be a challenge. The practical options to account for quality change and new products are different for different tariff strategies.

Matched samples

9.4.30 The detection of quality changes depends on the degree of detail in the product specifications at the lowest level of the index. This is because the matched sample method will not take account of price changes outside the specifications, for example, those related to the total volume of the

service used. In the matched sample approach, the quality change situation can be thought of as similar to the situation confronted by a disappearing product, i.e. that some pre-specified element of the tariff is no longer available for pricing. A replacement should be selected for the disappearing element of the tariff and the elements compared directly (where applicable) or treated as entirely new products. An illustrative example follows for public transport bus fares.

Public bus transport in City X

Old tariff element. Bus fare from city centre X to Suburb Y, on a Saturday, 10.30 pm. (night tariff, last connection)

- New tariff element. Bus fare from city centre X to Suburb Y, on a Saturday, 9:30 pm. (night tariff, last connection).

9.4.31 The basis for the direct comparison is the index compiler's judgement, that from the consumers' point of view the change in timing is not a significant change.

9.4.32 The price statistician could also reason that the quality of the service has changed and an allowance for that should be made in the index. But in drawing this conclusion and making a quality adjustment the CPI statistician should not use their subjective judgement or personal view. In this particular example some travellers may consider this change in tariff and timetabling as a reduction in quality of service if last shows at cinemas finish at 9:45 pm mean that a bus journey is replaced by an expensive taxi journey home, but it could well be that other users of the bus actually welcome the earlier timing because most restaurants close at 9:15 pm and they can now avoid waiting for a bus until 10:30 pm. in the cold. So for them it is a quality improvement. If possible the price statistician should canvass the views of users for an indication of whether the change is considered to be for the better or for the worse. An indication of subsequent changes in passenger numbers may confirm whether the initial assessment was correct but even this involves some judgement. The decision to use direct comparison, without quality adjustment, is always to a certain extent judgemental and should therefore be based on explicit lines of reasoning so that it is transparent and can be justified.

Unit values

9.4.33 The unit value approach regards quality differences related to different pricing schemes as implicit price differences. The detection of quality change depends on the degree of detail in the specification of "the unit of consumption". Unit values perform best when there is a high degree of homogeneity. To prevent quality differences from affecting the price index, the specifications of the "units of consumption" should be as detailed as the available data permit to maximise homogeneity.

9.4.34 In the example below (Table 9.4.3), relating to bus fares for juveniles, the previous tariff categories have to be 'transformed' into the new ones. For customers aged from 12 to 16 there was a price rise of 60 percent (from $5 to $8) while for 16 year olds there was a price decrease of 20% (from $10 to $8). The proportion of customers falling in these categories, i.e. the previous consumption patterns, should be used to calculate the average price change, or in the absence of such information the price statistician might make an assumption about the proportions based on the available information, including revenue information from the bus company.

Table 9.4.3

	Current ticket prices ($)	**New ticket Prices ($)**
Children	5-15 years = $5	5-11 years = $5
Teenagers		12-16 years = $8
Adults	16 and above = $10	17 and above = $10

Consumer profiles

9.4.35 The key issue when dealing with quality changes in the context of consumer profiles is the choice of which consumer profiles should be priced through the period of tariff change and/or change in service provider. The example of a profile given below is based on a situation where broadband internet providers increase their download and upload speeds substantially, while keeping prices constant, or reducing them. In this example it is assumed that the differentiating factors of an internet-provided broadband connection are the download and upload speeds and that this is reflected in different tariffs (see Table 9.4.4). It therefore follows that the increase in speed is a quality enhancement – in the market place it is a price-determining characteristic. As a result of the increase in speed, it will take less time to download and upload files. However this time advantage will only be noticeable when downloading or uploading large files.

Table 9.4.4 Internet Services

Service level (slow, medium or fast speed)	Current speed in Kbit/s (down/up)	New speed in Kbit/s (down/up)	Difference in speed (%) (down/up)	Current Price ($)	New Price ($)
Slow	256/64	384/96	50/50	34,90	34,90
Medium	768/128	1024/160	33/25	52,25	52,25
Fast	1536/256	2048/320	33/25	86,10	79,95

9.4.36 The assumption is made that the product versions provided are also, in effect, descriptions of consumer profiles:

- Low volume users who are mainly interested in having access to the internet when needed.
- Medium volume users who require and pay for some additional functionality.
- Heavy users who are ready to pay for additional performance.

9.4.37 It can therefore be argued that the fee, for low volume users and their associated download/upload speeds, is a price for access to the service while the more expensive versions also contain a price for the use of the service.

9.4.38 The price for the use component – which, as described above, only exists for medium and high volume users – is derived by subtracting the fee for the cheapest available subscription from the total fee. Subtracting the download speed of the low-volume user from the speed provided to medium and high volume users (in each period) determines the volume associated with this fee. The key point is that a unit price for the 'volume of use' is calculated for each class of consumer, in essence, a form of stratification is applied. The base period and current period situations are as follows.

9.4.39 In the far right-hand column of Table 9.4.6 (the second of the tables below), the total price of the new scheme has been re-calculated using the user-based structure – in this case the features of the packages provided – for the comparison period. The quality adjusted price change, which allows for quality changes in different schemes, is obtained by dividing the price of the adjusted new package by the price of the old package in the base period, the latter being given in Table 9.4.5 - (49.85/56.38 = 0.88), i.e. a 12 percent price decrease.

9.4.40 The direct comparison of the two tariff schemes, disregarding the quality change, would result in price change 54.84/56.38 = 0.97, i.e. a 3 per cent decrease in price.

Table 9.4.5 Internet Prices: Base Period

T0	Share of products	Download speed	Total price	Price of the access	Price of use	Volume of use	Unit price of use	Total price of the scheme
Light	0.25	256	34.90	34.90	0.00	0	0.000	34.90
Basic	0.5	768	52.25	34.90	17.35	512	0.022	52.25
Fast	0.25	1536	86.10	34.90	51.20	1280	0.033	86.10
Average price of the operator (weighted):								**56.38**

Table 9.4.6 Internet Prices: Comparison Period

T0	Share of products	Download speed	Total price	Price of the access	Price of use	Volume of use	Unit price of use	Total price of the scheme	Total price of the scheme, T0 user structure
Light	0.25	384	34.90	34.90	0.00	0	0.000	34.90	34.90
Basic	0.5	1024	52.25	34.90	17.35	640	0.016	52.25	47.91
Fast	0.25	2048	79.95	34.90	45.05	1664	0.022	79.95	68.69
Average price of the operator (weighted):								**54.84**	**49.85**

New service providers and new products

9.4.41 From the consumer's point of view many tariff-priced services are relatively uniform. Electricity delivered to the consumer is almost homogeneous by definition, the main difference in service level being reliability of supply. The same may hold true for other services, like telephone services or internet-services, despite the service-provider's attempts to differentiate their products and make their pricing structures more and more opaque. Therefore different suppliers of tariff-priced services could be considered as providing the same type of service and treated as substitutes for each other.

9.4.42 Changes in the market mix of a clearly homogeneous product from different tariff structures and suppliers should be incorporated in the index. Index construction will require information about the market share of different producers and the various service plans. As a general principle, for homogeneous services the price impact of a new service provider should be shown in the index, i.e. the target price measure for homogeneous services is the unit price in the overall market for the service, quality adjusted as necessary.

9.4.43 In some tariff-priced parts of the retail market new service elements are frequently introduced (for example, multimedia messages or e-mail on cell phones). These should be introduced into the pricing schemes or consumer profiles by chaining, once they have significant market share (see Chapter 8).

Classifications

9.4.44 CPI classification systems in use by many countries, including COICOP, are not constructed with a stratification structure that is sufficiently detailed to reflect the various tariffs for those commodities that are subject to such pricing practices. For example, electricity under the COICOP hierarchy appears as a product Class (4-digit COICOP) in its own right (04.5.1) and according to its official description includes: associated expenditures such as hire of meters, reading of meters, standing charges, etc. A finer breakdown is not given in COICOP. However, when sellers of a commodity, such as electricity, use tariff pricing, the accuracy of the CPI can be improved if the price index for this commodity is constructed in a way that reflects as accurately as possible the market realities. In other words, a class-level price index should be comprised of a number of sub-indices, each one corresponding to its particular tariff price. This may require the use of a specially designed classification for the purpose of stratification within an elementary aggregate.

CHAPTER 9.5

Special Cases - Seasonal Products

Introduction

9.5.1 The topic of seasonal commodities, prices and weights is covered in Chapter 22 of the CPI Manual and is mentioned in various paragraphs in other chapters. It distinguishes between "strongly" seasonal commodities which are available only part of the year when "in season" and "weakly" seasonal ones are available throughout the year but their prices (and their consumption) fluctuate with the time of the year. "Weakly" seasonal commodities generally do not require any direct intervention by the compiler. The seasonal fluctuating prices of "weakly seasonal products" will typically be captured in the index although they are not without their problems for users of a CPI. For instance, when the "weakly" seasonal commodity is "out of season", its price may be unusually high or low and the annual basket will reflect these unusual price fluctuations, leading to seasonal fluctuations in the overall index. This volatility can cause "statistical fog" with the analysis and understanding of inflation. For some purposes users want a CPI which measures the underlying price change and not these seasonal fluctuations. The use of moving averages can help as can various measure of "core inflation" (see Chapter 11). But it is the "strongly" seasonal products which pose the biggest problem for the index compiler.

9.5.2 The 2003 ILO Resolution recognises that seasonal products should be included in the CPI basket but may need special treatment. It states that "the way these products are dealt with should be determined by the main purpose of the indices, national circumstances and the practicalities of compilation". It then goes on to refer to two methods for their inclusion; a *fixed-weight approach* which uses the same weight for the seasonal product in all months using an imputed price in the out-of-season months; a *variable weights approach* where a changing weight is attached to the product in various months. The same two main methods are covered in the CPI Manual for dealing with "strongly" seasonal products.

9.5.3 There is at present no generally agreed approach as to the best way to treat strongly seasonal commodities. Ignoring the issue and excluding all the possible 'problematic' products from a CPI is not a solution in the context of an index whose purpose is to reflect changes in all consumption prices. If these products have some importance in the index basket then there is no justification for ignoring them. This section looks at the alternative ways of dealing with strongly seasonal products.

Background

9.5.4 Climate, traditions and institutional arrangements are the main causes of seasonal unavailability. Fresh fruit and vegetables often have a particularly marked seasonal purchasing and consumption pattern and certain fruit and vegetables may not be available at all at certain times of the year. Other products which can display some seasonality include clothing, water and fuel. The list of seasonal commodities cannot be expected to be uniform across countries. For examples, oranges may be available for purchase year-round in warmer climate countries but only in certain times of the year or at a premium price in cooler climates. Certain religious and other festivals can also be associated with goods or services whose consumption is limited wholly or partially to the festival period, such as Christmas trees, or products which are in high demand or especially produced, such as some gifts given at the end of Ramadan.

9.5.5 Strongly seasonal items are the most challenging for index compilers since having different bundles of items in the CPI basket in the months (or quarters) being compared leads to a breakdown of traditional bilateral index number theory. In the context of producing a monthly or quarterly CPI, it must be recognised that there is no completely satisfactory way of dealing with strongly seasonal commodities. This chapter presents several solutions to overcome the problem, which include traditional month-to-month indices (along with their limitations) and annual approaches, which take advantage of the fact that seasonal items might appear in broadly the same month every year. Index number theory does provide particularly effective solutions where the focus is to compare prices in one month with prices in the same month a year

earlier. But the estimate of month-on-month inflation can vary, depending on the approach which is used, making the analysis of short-term inflation trends difficult, since in the absence of price quotes in particular months, no month-to-month price ratio can be compiled without imputing a price. The results will depend on the method of imputation. Alternatively, a zero weight can be attached to the missing product but this also raises issues and hinders month-to-month comparisons.

9.5.6 The difficulties that are raised by the existence of "strongly" seasonal items and their seasonal unavailability can be tackled by choosing one of two main approaches:

- The *fixed weights approach*. Allocating fixed annual weights, assuming that seasonal products are to be treated in the same way as all other products.
- The *variable weights approach*. Allocating variable weights, according to the consumption pattern found in the base period.

Fixed weights approach

9.5.7 This approach, where the weights remain constant over all months of the year and which imputes a price when the product is out-of-season and not available to price, is theoretically consistent with the concept of a fixed basket. However, it raises the issue of the choice of imputation method for the unobservable out-of-season prices. The most commonly used approach is to impute a price using the last available observed price (that is "reliable") and multiplying this last available price by the amount of price inflation for the most "similar" group of products that has taken place since the time of this last available price. The latter might be, for instance, a "similar" product or group of products, which is in season. The missing prices can be estimated using the monthly rate of change in the prices of the set of products within the same COICOP class or using an appropriate sub-set. Higher level aggregates inflation is likely to be influenced to a large extent by factors that are not so relevant for the seasonal product. Using products from the same COICOP class or group also enhances comparability with the variable weights approach, thus increasing statistical integrity.

9.5.8 The updating index could be an elementary one that uses Dutot or Jevons averaging, depending on the formula used for the CPI at the elementary aggregate level or it could even be the CPI as a whole if there is no "similar" group of products.

9.5.9 The other approach to imputation is to carry forward prices. In other words:

$$\hat{p}_m = p_{m-1}$$

9.5.10 The main drawback of the fixed weights approach is that the annual fixed weights will not be representative of the monthly consumption pattern. Oranges might be available for sale only in some months but the fixed weights approach "pretends" that they are on sale throughout the year and introduces artificial prices which do not actually exist in the market place but which are based on the price movements of a "comparable" product, such as bananas, that in reality may be of limited comparability. The limited comparability of the "comparable" product can lead to an extreme fluctuation in the oranges sub-index when oranges return to the market and are available again for direct pricing. But that said, in practice the fixed weights approach does normally give reasonable smooth 12-month rates of changes. The imputation of prices by reference to the most "similar" group of products normally reflects reasonably well the price inflation expectation when the product returns to the market and thus is often considered appropriate for the medium and long-term measurement of inflation. However, the use of carry-forward prices can, of course, bias the month-to-month changes to zero.

9.5.11 There are alternative methods for the imputation of prices to the one described above. For example, another option is to apply the following procedure:

- In the first month of the out-of-season period the price of an out-of-season product is estimated by a typical or average price observed during the in-season period.
- From the second month on, the price of an out-of-season product is estimated by applying the price change for a set of related products or a product for which prices have been observed for the current month to the estimated price from the previous step (i.e. the typical or average price observed during the in-season period).

9.5.12 In summary, the advantage of the fixed weights approach where missing prices are imputed is that it is easy to explain and implement and keeps the annual basket methodology more or less intact.

9.5.13 A word of caution is necessary at this point. It should be noted that ideally whatever method is applied to deal with seasonal items should be "self-correcting", i.e. if the item after the out-of season period reappears at the same price as it left the market, then the method should ensure that this

will take the index back to 100. Similarly, if the price reappears 10% higher, it should take the index to 110 etc. Carrying forward is self-correcting, provided that the price statistician includes the full price change from the last carried forward price to the new price (assuming constant quality) or, if quality has changed, the full quality-adjusted price change.

Variable weights approach

9.5.14 This approach introduces into the index changing seasonal consumption patterns, reflecting the reality of the retail market. It is usually applied within a COICOP category, the weight for the latter being held constant. The underlying assumption is that total expenditure on the relevant COICOP category (often synonymous with an elementary aggregate) does not vary between different times of the year, the main tendency being for expenditure to switch between "similar" items only (consumers will tend to buy more apples if oranges are not available). With the variable weights approach there is a different basket for each month, the general principle being that an item's weight in a given month is a reflection of the expenditures associated with the items in that month. Linking the monthly baskets provides the means of calculating the monthly changes for baskets that differ from month to month.

9.5.15 As well as reflecting the market, the variable weights approach also has the advantage of minimising the practice of price imputation, as prices will not be imputed for those months when the product is not available for purchase. Prices are observed only in months where weights are above zero. For products that have prices observed in two consecutive months, the monthly changes of the product price indices are computed using matched samples. When weights change from month to month, but remain positive, this does not have any influence on the price observation process. When a product has a positive weight after the weight has been zero for some months, the product index is compiled by matching the price observation in the first month of the new season with the observations from the last month of the previous season and applying the difference to the last index of the previous season to give the article price index for the first month of the new season.

9.5.16 The variable weights approach has two particular disadvantages

- It is conceptually inconsistent with a fixed basket index.
- Month-on-month price changes reflect not only changes in price relatives but also changes in consumption baskets (i.e. the weights). This makes it difficult to interpret month-on-month changes in the price index.

9.5.17 In addition, concerns have been expressed about the fact the seasonal weights are determined by past consumption patterns so that abnormal seasonal fluctuations are not taken into account. These fluctuations may be significant and undermine the index (although it can be argued that such abnormal fluctuations do not warrant special compilation procedures even when known in advance). Also, the variability in the precise timing of the seasons from one year to the next means that the imputation of prices is not totally avoided. For instance, if unusual weather conditions delay the appearance in the market of, say, oranges, then prices would need to be imputed for the months in which oranges are unavailable but where they have been allocated a non-zero weight. It should also be noted that the variable weights approach implicitly allocates the weight of out-of-season products to those products that are available for price observation in the current month, i.e. products which are in-season. This means that the variable weights approach impacts on the implicit weight given to non-seasonal and in-season products sharing the same COICOP group or elementary aggregate – which could be the case in reality.

9.5.18 The variable weights approach can be based on one of two options:

- A seasonal basket at base month prices
- A seasonal basket at base year prices (the 'Rothwell index').

9.5.19 Along with the previously discussed (fixed-weight) Lowe index, the Rothwell Index (also known as the Bean and Stine Type C) is the formula that is used by a number of national statistics institutes. Calculating this type of index using an artificial dataset indicates that these indices can have smaller or larger seasonal movements than the Lowe index and, contrary to earlier studies, are not always less volatile. Paragraph 22.11 of the CPI Manual describes the Rothwell index in more detail.

9.5.20 It is strongly recommended that the set of products defined as seasonal should not vary from year to year, unless strongly justified on grounds of necessity to keep the sample representative.

9.5.21 The use of the Rothwell formula, and other methods using variable weights, brings in monthly weights for seasonal commodities when the main part of the index is a fixed basket Lowe index using

annual weights. Thus the conceptual basis is compromised.

Fixed or variable weights?

9.5.22 Comparing the fixed and variable weights approaches it can be seen that the two approaches are not necessarily unrelated. The imputation of prices based on the price movements of similar products – the fixed weight approach - can be seen as a form of re-weighting where further weight is given to the price movements of products which are available for pricing. But the two approaches are not, of course, equivalent.

9.5.23 A 'perfect' solution to the treatment of seasonal items does not exist, particularly where the existence of seasonal commodities (and strongly seasonal commodities especially) means that it is impossible to compute a completely satisfactory month to month index that accurately measures month to month price change.

9.5.24 If the focus of the CPI is the accurate measurement of annual price inflation, then the problems associated with strongly seasonal commodities mostly disappear (although changes in seasonal patterns from one year to the next continue be problematic[32]).

9.5.25 The advantages and disadvantages of each method should be considered and, if possible, the impact on measured inflation assessed for reasonableness before a particular method is implemented. The use of the index will also be an important consideration. For example, if the main purpose of the index is for indexation then the fact that the variable weights approach means that the month-on-month price change will reflect not only changes in price relatives but also changes in consumption baskets may be considered a significant disadvantage, i.e. users might question the meaning of comparing the price of this month's basket with the price of last month's basket which might be very different. More generally, if user focus is on month-to-month change then the variable weights approach is recommended, despite the problems of interpretation, as the annual weights attached to each month-to-month price relative can be misleading. If user focus is on long-term index changes then the use of an annual basket and annual expenditure shares is likely to be most appropriate.

Estimation of weights

9.5.26 In the context of the variable weights approach, it may not be practical or possible to create seasonal baskets for all goods and services which are subject to seasonal effects. For this reason the variable weights approach is normally applied only to products for which seasonal weights data are available and for which the expenditure weight is significant. For instance, some countries will thus limit their seasonal basket to certain food items such as fruits and vegetables. But there are additional reasons for keeping the use of variable weights to a minimum. These are the relations between variations in the overall index level and changing weights on the one hand and the use of fixed monthly weights for non-seasonal products on the other hand. This can be achieved in the first place by defining seasonal products only on the basis of non-availability during part of the year. Products with fluctuations in the consumption level between months, but which are available all year, have prices which can be measured and are not abnormally high, should not be considered seasonal products in the current context.

9.5.27 The Household Budget Survey (HBS) has traditionally been the favoured source for seasonal or monthly CPI weights where the information for recurring expenditures, such as food, is collected with a one or two week diary that is continuous over the year. Consequently, the monthly expenditures for many products that are deemed seasonal can be derived as long as the needs of the CPI compiler have been discussed and taken into account in the survey design of the HBS.

9.5.28 The average expenditure per household from the HBS for three consecutive years rather than just one is often used to calculate the seasonal item weights in order to reduce sampling error and also to reduce the effect of unusual monthly patterns of consumption in any one year - which can be a common occurrence for seasonal foods. The values for each of the 36 months are price-updated (see Chapter 4 on weights) to the current base month, January say (or alternatively the base reference period, a year say[33]), or base period, by multiplying by the appropriate current January item index and dividing by the corresponding index value relating to

[32] The focus on annual price inflation leads to the possibility of a further solution - the construction of 12 year over year monthly Lowe indices (or geometric Young indices or four quarter over quarter indices, using seasonal baskets that are appropriate for each month or quarter. From a practical point of view, annual household budget surveys would have to be augmented to cover seasonal commodities in more detail and this would entail more expense. But if a statistical agency is using the Rothwell formula, then it is already collecting seasonal expenditures information.

[33] There are some problems involved in price-updating seasonal products to a given month, as some products may be out of season in January – thus it may not be possible, or they have to be price-updated with some imputed/estimated price development.

the corresponding reference period for the HBS data. A simple average of expenditure in the three years is then taken for each calendar month. The monthly weights for each item are a percentage of the total monthly expenditure in the section, rounded and adjusted so that the weights sum to 100 (or 1000)[34].

9.5.29 The steps in computing the weights can be summarised as follows:

- Determine the yearly average weight per product within the COICOP class or group of seasonal products.
- Determine the out-of-season months.
- Compute the monthly weights of the in-season period in an iterative method, which ensures that:
    - Monthly weights per COICOP class or group are equal each month.
    - Weights are zero in out-of-season periods.
    - The average product weight during the year represents the annual weight.

9.5.30 If one or several products have a large weight and a short season, the HBS may not have sufficient expenditure information to compute a weights distribution. The same sort of data problems may also occur when in one or several months only a few products are available for pricing with small weights but where detailed expenditure information is not available from the HBS. The only practical solution is to try to extend the price observation period of some products or to change the annual product weights used in the calculation. It should be noted that this practical problem occurs in any scheme of seasonal weights and is not related to the procedure of minimizing the weights fluctuations.

[34] Alternatively for the purpose of simply aligning expenditure data, thereby avoiding the underlying assumption of fixed quantities associated with "normal" price-updating where item weights (elementary aggregate weights) are multiplied by different price-indices, the overall (all items) CPI can be used. If the HBS is available for, say, three years 2005 - 2007 and the CPI statistician wants to refer all data to the middle, he or she multiplies all the expenditures in the 2005 HBS by the overall CPI from 2005 to 2006. Thereby, the 2005 data are referred to the level of prices and quantities of the reference year, 2006. In the same way, the expenditure data from 2007 for all items are multiplied by the CPI from 2007 to 2006. After this, the expenditures are added and on this basis the weights - the expenditure shares - can be calculated.

Monthly approach: maximum overlap – not an alternative

9.5.31 This type of index deals directly with the seasonality problem but strictly speaking is not an alternative to the fixed and variable weight options for dealing with particular products – rather it is a method of index construction which overcomes the challenges of seasonal products by taking into account only those observations present in both compared months. In this case it seems reasonable at first glance to prefer a chained index, which compares prices in adjacent months because a fixed-base index could fail to effectively follow closely market-place developments. This is due to the dynamics in the retail market resulting from seasonality, the introduction of new commodities, and disappearance of older ones.

9.5.32 The expenditure shares for month *m+1* are calculated excluding the commodities not priced in that month.

9.5.33 The main problem of the maximum overlap price index is that it can have a significant downward bias due to the chained nature of the index. Seasonal commodities tend to enter the market at relatively high prices, which drop in the subsequent months. The initial high prices are not always captured by the maximum overlap index. The maximum overlap method is not recommended when there are particularly large price variations.

9.5.34 In summary, the month to month maximum overlap method is generally not recommended due to possible chain drift bias. However, the method can be checked to see if this is a problem by comparing the product of 12 consecutive month to month maximum overlap indices with the corresponding direct year over year comparison. If the product of the 12 links is fairly close to the corresponding year over year index, then the month to month overlap method can be used.

Rolling Year Index – an alternative method of presentation

9.5.35 The calculation of a rolling year index is a way of overcoming some of the volatility problems associated with the fixed and variable weights approaches described above. Any 12 consecutive months of price and quantity data can be compared to the price and quantity data of the base year, provided that the January data in the non-calendar year are compared to the January data of the base year, February to February and so on.

9.5.36 The presentation of 12-month rolling averages can be regarded as a measure of inflation for a year that is centred on six months prior to the last month in the current rolling year.

9.5.37 The Rolling Year fixed base index can be viewed as a basic form of a seasonally adjusted annual index. It should be noted that this type of index does not measure short term month-to-month price fluctuations and so there is still a role for a "regular" month to month CPI.

9.5.38 The formulation for a Laspeyres index is to calculate the price index, for example, for April 2005, with a base year of 1997. The year January to December 1997 must be used in the denominator and May 2004 to April 2005 in the numerator, i.e. the "rolling year" is used only in the numerator.

9.5.39 In the case of a rolling-year chained Laspeyres index, the, rolling-year months are used both in the numerator and denominator. The January to December whole year is used only once, in order to calculate the first year indices.

9.5.40 There are many examples in the CPI Manual to which the reader can refer. The detailed formulations are given in Chapter 22 of the CPI Manual.

Some common implementation problems

The identification of seasonal items in the basket and the corresponding length of the seasonal cycle

9.5.41 The most important characteristics which can be associated with a strongly seasonal product are: that it is not available for purchase during certain months (or the quantity available for purchase is negligible): that there is a significant variation in demand during the course of the year; that there are corresponding large fluctuations in price. The variations in supply and demand, means that prices cannot be or are not observed during these months. Seasonal products are associated with variations both in availability of products and in their demand and this can lead to pronounced variations in stocks in outlets, expenditure levels and prices. Any period of non-availability for pricing in outlets should have some typical annual cyclical pattern. If for some special reason a product becomes unavailable in a month where it would normally be available and sold at a normal price, this does not make it a seasonal product. The out-of-season period of a product includes the months in which no prices are observed or used in the compilation for that product because the product is not available for pricing or only available in small quantities at abnormal prices. The latter point is important because the inclusion of abnormally high "start-of-season" prices relating to low volume sales can introduce a downward bias in the index- for both the fixed weight and variable weight approaches. It may also cause difficulties for price collectors attempting to find the products. For instance, seasonal fruits and vegetables may return to the market initially at low volume and high prices, after which prices fall rapidly as supply floods the market. Later, prices may rise as supplies fall. Statistical offices should analyse past data and construct some experimental indices to help inform decisions, which will inevitably involve some judgement by the price statistician.

The geographical dimension

9.5.42 The seasonal availability of products may vary between regions within a large country. There may also be a difference in supply (and demand) between markets in rural areas and those in urban areas, or between market stalls and more upmarket shops catering for the better off. For example, some prices may be collectable in the capital city even though the product is generally not available elsewhere. Where this is the case, different seasonal cycles may be applied, particularly if the differences are marked and regional or urban/rural sub-indices are being computed. The decision should take account of the extent of the differences and the needs of users.

Lack of well-defined seasons

9.5.43 In practice, seasonal commodities do not always appear and disappear in the same month every year. This presents a problem both for year-on-year monthly comparisons of monthly indices as well as for year-on-year comparisons of quarterly indices, but is particularly pronounced for the former. The consequence of neglecting the importance of carefully pre-defined seasons can contribute to a method, particularly the variable weight approach, failing to correctly reflect the price changes in the price index in the short-term. Decisions made regarding the relevance of prices which could have been observed but were not (and have not been included in the index or the imputation of non-existent prices can affect the stability of the price index. Thus the fact that seasonal patterns change and the need to confront whether to accept this or force data into a pre-determined seasonal pattern poses a dilemma to compilers of the CPI. It is particularly important that when data are published, the statistician should

provide background explanations for the 12-month rate of change, and in particular whether this is influenced by a change in the timing of sales and in what direction and by what magnitude.

Home produced products being replaced with imported products when out-of-season

9.5.44 The product description is important in these circumstances. The price statistician will need to make a judgement on whether the imported apple is of the same quality as the home grown one and if so whether it can be treated as an "equivalent" fruit. This judgement should be based not just on variety of apple, its general condition and flavour but also on whether the market perceives it to be the same and treats it as the same. For instance, the imported apple may be so highly priced that only a small number of well-off consumers will buy it. It may then be regarded as being unrepresentative and not equivalent to the domestic apple, and excluded from the sample. The decision to exclude the imported apple may be made even if the apple is of the same variety as the home grown one. It is important, of course, that the price collector is properly trained to identify these product changes.

9.5.45 In order to correctly define the months in which the price index of the seasonal commodity will be calculated from observed prices, particularly in the situation where the methodology requires a fixed seasonal pattern, the statistical office should examine in depth the historical data on quantities and prices for each commodity and undertake a sensitivity analysis to identify working rules for determining the inclusion and exclusion of products in the index in specific months:

- The quantity data are needed in order to decide whether it is likely that in any specific month the product will keep returning to the market every year. Unfortunately most Household Budget Surveys record expenditures rather than quantities but other data sources might be at hand relating to retail sales.
- The prices data will show how inclusion of the product in the index for the first month in which the product returns to the market may contribute to the volatility of the index. For example, if the entry price is particularly high (say, more than 250% higher than the commodity's last actual price), then it would be reasonable to consider not including the product for that month, especially as it is improbable that the product was widely purchased at such a high price.
- Strongly seasonal products enter the market at high prices that diminish towards the end of the season but, as already argued, can go up sharply before exiting the market. This will also have an impact which may vary depending on the calculation approach used.

Some common seasonal products and their treatment

Fruits and vegetables

9.5.46 The prices of seasonal fruits and vegetables are strongly dependent on supply conditions, such as weather, and are thus liable to show extreme price movements and shifts in seasons as well as seasonal unavailability. However, changes in specification or quality are not common and therefore do not cause the same problems as are experienced when dealing with, for example, seasonal clothing (see next section).

9.5.47 There is no consensus on whether the fixed or variable weights approach is the most appropriate.

Clothing

9.5.48 The treatment of seasonal clothing can be far more problematic, especially if fashion is involved. In many countries the price patterns of clothing are the result not just of seasonal availability (for example, winter coats, bathing suits) but, especially for fashion goods, of discounts in seasonal sales (Chapter 6 provides specific guidance on the latter). In addition, the problem of extreme price movements is combined not only with seasonal unavailability but by annual changes in the products themselves, in other words, the effect of fashion. New stocks of clothes that arrive in the shops at the beginning of their season may have styles that are different from those that disappeared at the end of the previous season, so there is the question of whether the new styles are different in quality from the old styles. In addition, prices generally fall over the course of the season: prices at the end of a season are often discounted as shops clear their stocks in readiness for the next season. Of course, for seasonal items, comparisons must be made between the new replacement products and the old products that disappeared at the end of the previous season, maybe six months earlier. Dealing with these issues can be challenging:

- *Specification changes*. Since it can be difficult to make like-to-like observations for many categories of clothing, the rules for judging whether a replacement is comparable to an

original item may need to be somewhat relaxed. For example, this season's high-fashion coat can be viewed as comparable to last season's model unless there are obvious differences in important characteristics such as textile replacing leather. For high-fashion items, only changes in compositional and material characteristics, if significant, should be treated as quality changes – see Chapter 7. The primary characteristic of most high-fashion items is the product brand, which incorporates the fashion element. Keeping the same or an equivalent brand is often the key to measuring the fashion element. (See CPI Manual paragraphs 10.66–10.72.)

- *Discounted end-of-season prices*. In the case of a product showing temporary discounts or promotions, where it seems likely that the price will return to its normal level after a short period, then the discounted price should be included and no special method is needed to handle it. If, however, the discounting is seasonal in nature and intended to help the shop clear stocks of old styles, then the issue is more problematic because, unless specific procedures are applied to ensure a return to normal prices, the index will be subject to a systematic downward bias. The exclusion of such situations is an important consideration in defining the in-season period. Products that have flaws or are shop-soiled should not be included.

9.5.49 As a result of the above complications, some statistical offices employ the following procedures during the period covering the time when a "seasonal" clothing item is not available. This adopts the fixed weight approach but imputes missing prices by applying price movements (using the overall mean or the class mean – see Chapter 7) to the last available normal price:

- In the first month that the item is unavailable, record the price at its "normal" level; in other words, in the first month impute the last available normal price.
- Impute a price during the period of unavailability, for the second and subsequent months, by applying the monthly movements for clothing items for which prices are available to the last normal price.
- When the normal season resumes, select a replacement as similar as possible to the variety that was priced during the previous season and compare its price directly to the final imputed price of the old variety. It is important that the index reflects the full extent of the price difference between the last month in which a price was imputed and the first month of the new season. If the replacement has a different level of quality, then the price should be adjusted using one of the quality adjustment methods presented in Chapter 7.
- Continue price collection using this new variety for the new season.

9.5.50 The reader should refer to Chapter 6 for further guidance on the treatment of "sale" prices.

Intractable problems and serious challenges?

9.5.51 In the context of constructing a month-to-month index that accurately reflects price inflation facing households, there is no fully effective method of dealing with large monthly fluctuations in prices and quantities generated by strong seasonality. The fixed and variable weights approaches each have merits as well as defects. If user focus is on month-to-month change then it has been argued that the variable weights approach is probably the preferred method as it avoids the problem associated with the fixed weights approach where the annual weights attached to each month-to-month price relative can be misleading. But the fixed basket has been compromised unless year-on-year comparisons are made. From a presentational point of view, indices showing the twelve-month inflation rate assist in trend analysis but do not easily identify changes in the monthly trends. It has already been noted that month-to-month indices using maximum overlap are prone to downward bias.

9.5.52 Indices can be seasonally adjusted using seasonal adjustment factors or rolling year indices or by traditional approaches such as the use of three month moving averages. The latter are covered in Chapter 11 on Special Indices.

9.5.53 It is recommended that statistical offices undertake pilot studies with historical data before making a decision on which approach to use. Finally it should be noted that when estimating the contribution of a sub-component of the CPI to the change in the All Items CPI, the way this is calculated is different for a seasonal component. This is dealt with in Chapter 14.

CHAPTER 9.6

Special Cases - Second-Hand Goods

Introduction

9.6.1 The purchase of second-hand goods can be important for some categories of household.

9.6.2 Paragraph 31 of the 2003 ILO Resolution on consumer price indices, states that "the expenditure weights for second-hand goods should be based either on the net expenditure of the reference population on such goods, or on the gross expenditure, depending on the purpose of the index". A CPI is generally understood to be a price index that measures the changes in the prices of consumption goods and services acquired and should normally use weights consistent with this concept. The *Consumer Price Index Manual* (2004) provides more detailed guidance on the appropriate weights in the CPI. Paragraphs 3.127 to 3.129 reiterate that second-hand goods are in scope and introduce the "net expenditure" concept, in other words total purchases less sales, for weights. The latter is in line with the national accounts concept of "household final consumption expenditure" as defined in the System of National Accounts (SNA) 1993.

9.6.3 The use of gross expenditures as weights for changes in the prices of second-hand goods in a CPI is inconsistent with the SNA[35]. The SNA states that sales of second-hand goods (i.e. partly used durables) have to be accounted for and are treated as negative expenditure in the SNA to be consistent with the treatment of the original purchases[36]. Furthermore, putting the national accounts argument to one side, the use of gross expenditure weights and the inclusion of disposals also would be inconsistent with an index based on acquisitions and could clearly overstate, potentially by a substantial amount, the resources that are devoted by households to acquiring second-hand goods. It is therefore not appropriate for either a cost-of-living-index (COLI) or a non-COLI (for example, a cost-of-goods index (COGI)[37].

9.6.4 In nearly all cases net weights should be used[38].

9.6.5 The *CPI Manual* elaborates four different scenarios on the issue of weights, all of which are based on the "net expenditure" concept:

1. *Directly from another household*. The net expenditure is zero as the transaction is between households. It follows that these purchases should be excluded from a CPI.
2. *From another household via a dealer*. This is where dealers purchase second-hand goods from individual households and then re-sell them usually after carrying out renovation, cleaning or maintenance. Theoretically these purchases should be included with a "net" weight reflecting the difference between the buying and the selling price which is deemed to

[35] The SNA does not directly treat household durables as household assets or their acquisition as capital formation. The one exception is dwellings (see footnote 2). However, through a recognition that household durables are goods that can be used repeatedly or continuously over time, the SNA does indirectly recognise them as a household asset, despite their purchase being treated as consumption. So by implication durables are subject to the SNA guidelines relating to expenditures on gross fixed capital formation. These guidelines explicitly define the latter as acquisitions less disposals of fixed assets.

[36] More particularly, the SNA recommends that sales of second-hand goods are to be recorded as an expenditure within the purchasing institutional sector and a negative expenditure on the part of the selling institutional sector. So, any sale/purchase between households has no impact on HFCE, unless an intermediary such as a car dealer is involved, in which case the dealer's margin adds to HFCE. On the other hand, if a household purchases an ex-rental car then the whole value of the car is recorded as HFCE (and negative capital. The various scenarios are described in more detail in paragraph 9.6.5.

[37] A cost-of-goods index measures the percentage change in expenditure a household requires to purchase a fixed basket of goods and services. As its name implies it seeks to measure the change in cost. In contrast, a cost-of-living index measures the percentage change in expenditure needed to maintain a household's standard of living. As its name implies it s objective is to measure the change in the cost –of--living.

[38] There is one important exception that occurs when the user cost approach is used for the measurement of owner-occupier housing costs. The loan costs associated with house purchase enter the index. Under an acquisition approach owner-occupied housing would be based on a net acquisition cost basis i.e. the cost of purchasing all newly built houses or converted dwellings or existing dwellings newly acquired by the household sector (for example, private purchases of houses previously owned by the government) less disposals of houses (such as demolitions or sales of private houses to government).

represent the "service" the dealer is giving the buyer.

3. *Directly from another sector*, i.e. from another enterprise or from abroad. The appropriate "net" weight is household purchases from these other sectors less any sales to them.

4. *From an enterprise or from abroad via a dealer*. Following the same principles as applied above, the appropriate "net" weight consists of household purchases from dealers less household sales to dealers plus the aggregate value of dealers' margins on the products that they buy from and resell to households[39].

9.6.6 One consequence of using net weights, with sales and purchases being treated in the same way, is that it is necessary to reverse the sign of the price changes for second-hand goods sold by households for the CPI to properly reflect changes in the cost of living with the consequence that price changes for second-hand goods sold directly from one household to another will carry a zero weight. Thus for both a COLI and a COGI the text in the Manual can be simplified and "household" transactions in second-hand goods can be divided into three groups:

1. *Transactions between households*. The net expenditures are zero. The changes in the prices of the goods concerned carry no weight and have no effect on a CPI.

2. *Purchases by households from units in other sectors including the rest of the world*. The price changes are weighted by the values of the purchases or expenditures incurred.

3. *Sales by households to units in other sectors including the rest of the world*. The price changes are given negative weights equal to the values of the receipts from the sales.

9.6.7 In what circumstances can the use of gross expenditure weights be justified? As already stated, one consequence of using gross expenditure for weights would be that the weights carried by second-hand goods in the index would be greater than if net expenditures were to be used and too large compared with other goods and services as it would overstate in relative terms the amount of household resources taken up by transactions in second-hand goods. If the price of a second-hand good increased, the index would reflect the purchasing household being worse off but not the selling household being better off. Similarly, from a national accounts perspective, there is no justification for including acquisitions but arbitrarily excluding disposals. Such a procedure would be illogical and inconsistent with the SNA as a whole. Thus, putting aside some highly specialised uses, in general there does not appear to be a circumstance in which use of gross expenditures can be justified in a mainstream price index for household consumption, especially one intended to be used to adjust rates of compensation for changes in the cost of living.

9.6.8 From the above discussion, guidelines for the measurement of second-hand goods in a price index can be derived whose practical implications are most pronounced for durable second-hand goods such as houses where the treatment is dependent on whether a use, payments or acquisition approach is adopted (for further details see footnote 1 and paragraphs 10.4 to 10.50 of the CPI Manual and chapter 4 of this Handbook). The measurement of housing costs is considered elsewhere in this chapter. Where the second-hand good is a semi-durable good, such as for second-hand clothes and cars, its treatment is not practically affected by the whether the use, payments or acquisition approach is adopted.

9.6.9 Some goods such as vehicles may be sold by households to dealers who subsequently resell them at a higher price to other households. This implies that households' net expenditures on goods that are purchased indirectly from other households via a dealer should be positive. It can be argued that the net expenditures should be treated as purchases of intermediate services provided by the dealers and not as purchases of second-hand goods. The weight carried in the overall CPI is the same whichever interpretation is adopted although the estimated price changes might be different.

9.6.10 Weights are generally derived from Household Budget Surveys, which may or may not cover second-hand goods or may not have information to separate the weights of second-hand items from new items. Explicit weighting is recommended even when based on approximate estimates of expenditure. Administrative records of, for example, the value of imported second-hand cars and of changes in second-hand car registrations may provide an alternative source of information to compute approximate weights. Weights can be estimated "top-down" by taking total sales and making an approximate apportionment between old and new goods or "bottom-up" by computing separate estimates and totalling them.

9.6.11 There are several practical difficulties in pricing second-hand goods when using the traditional approach of sending price collectors to

[39] This covers both imports and domestic sales of former company cars.

outlets. Firstly, it can be difficult to determine what prices are actually paid, since bargaining is more common with second-hand goods than new ones, for instance concerning the condition of the item. Secondly, two sampling problems are particularly challenging:

1. The initial selection of a representative sample.
2. Following the prices of a fixed basket.

1. Initial sample selection

a) Items

9.6.12 A number of factors need to be taken into account when choosing a representative sample of a specific second-hand good:

- The items chosen must be generally available and easy to find by price collectors.
- The item description must be sufficiently detailed for the item to be easily identified both initially and on repeat visits to outlets and to provide sufficient guidance when a replacement needs to be chosen.
- The item must be representative of the second-hand market.

9.6.13 For most second-hand goods the selection of precisely which items to be priced is likely to be purposive. To facilitate this, the price statistician will need to identify not only which characteristics physically differentiate one item from another but also which factors have a significant impact on price, including, in particular, the condition of the good concerned. The latter may need to be deduced by observation based on a number of price influencing attributes. For instance, with clothing there may be noticeable thinning of the material. The attributes may be determined in part indirectly, for instance in the case of a car by reference to its age. These should make up part of the item description and be used when selecting an item to price each month.

9.6.14 Specifications should be kept up-to-date to reflect the second-hand market so that problems relating to sample depletion and "forced" replacements are minimised. Forced replacements are to be avoided particularly for cars as explicit forms of quality adjustment are problematic[40].

b) Outlets

9.6.15 The outlet needs to be representative of where second-hand goods are purchased, whether from shops, fixed markets or street traders. It also must be chosen with the need for continuity in mind so price collectors are able to collect as far as possible from the same outlets each month. It is likely that selecting the locations for price collection and the sample of actual outlets selling second-hand goods will be judgemental especially where street traders are involved. From a practical perspective there are two main approaches:

- Periodically conducting a full enumeration of the relevant outlets selling second-hand goods at a particular location and then selecting one at random for price collection each month. The difficulty with this approach is that it is not only resource intensive but also may not be particularly efficient in circumstances where it is unlikely that the item priced in a particular outlet at the previous price collection will still be available the following month as it will have been sold. (Second-hand goods are by definition unique). In addition it is not a practical option when outlets are moveable, which can often be the case for second-hand semi-durable goods (especially unbranded clothing).
- A form of quota sampling where the price collector visits a pre-selected location, for instance a market which is known to sell goods in a mid-price mid-quality range, taking a "random" walk around the stalls until a second-hand item meeting the required description is found. This may be the preferred method, especially under the circumstances described at (a) above and is a departure from the conventional CPI practice where the same outlet is visited each month and the same good is priced. Outlets and other points of sale for specific types of second-hand goods, such as clothing, can often be identified by their specific location on a market day. Choosing the appropriate day of the week is also important because street traders may change their position on different days .

9.6.16 In practice a mixture of the two approaches described above might be desirable and possible.

9.6.17 Under both approaches, stratification by outlet type - for example, shop, market stall and street trader - is recommended to keep the sample representative.

[40] For example, option costing, which is commonly employed for new cars, cannot be applied to second-hand cars, and hedonic regression techniques require a rich data source which is unlikely to be available. In these circumstances, expert judgment is often used to inform quality adjustment for differences in technical specifications, mileage or condition of vehicle.

2. Following the prices of a fixed basket

9.6.18 In ideal circumstances, after initial selection and pricing in an outlet exactly the same item should be priced each month. In practice this is almost impossible for second-hand goods as, for instance, exactly the same T-shirt is unlikely to be on sale in two consecutive price collection periods as it is likely to have been sold in the meantime. In any case, the price collector is unlikely to be able to identify and know whether he or she is pricing exactly the same good. A more practical approach, and a departure from normal price collection practice, is to re-select an item each month - in this case a T-shirt - which most resembles the one priced in the previous month. Selection of the new item is based on the price-determining characteristics previously identified. This is essentially option (b) above. To facilitate this approach, the price collector will need a check-list of characteristics for each item requiring a price quotation. This can be completed during the course of each price collection and a price adjustment made at head office where there is a deviation from the stated price-determining attributes. Advice from the retailer can be sought to assist this process. An example of such a form is given at Appendix 9.6.1 for a man's branded T-shirt. A similar form for a second-hand car is likely to include make and model, mileage and/or condition.

Quality adjustment

9.6.19 An over-detailed checklist of characteristics should be avoided as it can result in difficulties in locating products matching the exact definitions due to sellers not being able to guarantee that the second-hand goods that they acquire for re-sale will not vary from one period to another. This may in turn require a large number of quality adjustments as replacement items have to be constantly chosen. Where a matching item cannot be located, price collectors should be asked to collect the price of a product which most closely meets the specifications. The price statistician will then need to make a quality adjustment to the price to reflect the value of the difference (if any) between the specified item and its replacement. The option most suited to second-hand goods is expert judgement. This relies on commodity experts, often in consultation with shopkeepers, determining the value of a change in specification. This role is often undertaken by price collectors.

9.6.20 When there is a planned change of model, for instance in the pricing of second-hand cars, the use of overlap pricing is often seen as a way of making quality adjustments, as the prices of both old and replacement models can be collected in the overlap month. Their price ratios can be presumed to reflect the market value of relative quality when linking price quotes for different models. This removes any need for explicit quality adjustment.

9.6.21 Chapter 7 provides more general guidance on the subject of quality adjustment.

Alternative approaches

9.6.22 Given the potentially formidable practical sampling problems associated with collecting the prices of second-hand goods, as described above, some NSIs do not collect prices directly but instead adopt one of two possible alternative approaches, depending on circumstances and the goods involved. Either they ask a dealer in second-hand clothes to complete a questionnaire with the current price that they would expect to achieve. This is sometimes done for clothing, for instance, where market traders purchase bundles of second-hand clothes from suppliers (normally from other market traders who act as wholesalers) It is then assumed that retail prices will move in parallel to wholesale prices. Or they assume that the price trends for second-hand goods are the same as those of the corresponding new goods obtained from the main CPI price collection. The latter is most likely to be the practice where purchases of second-hand goods have been historically much less important than purchases of new goods. Both cases use other price movements as a proxy for the price movements of the corresponding second-hand goods.

Wholesalers' prices

9.6.23 Under this approach, the prices collected are wholesale prices that are used as a proxy for consumer prices. Wholesalers are selected so as to be representative of the types of wholesalers who are likely to supply the retail outlets that are used by the reference population covered by the CPI, taking into account such things as geographical coverage and the type of retail outlet supplied, including the income bracket of its customers. The product descriptions of the second-hand goods which are priced are normally more orientated to the wholesale rather than retail market in order to make sense to the wholesaler who has to complete the form. For example, the wholesaler may be asked to give the indicative prices, i.e. the current price he has been getting or expects to get for a "bale" of "average quality" T-shirts with designer logos. In this case "bales" are the standard quantity purchased wholesale, which will contain some good, average and low quality T-shirts mounting to a bale being of "average quality" overall. It is then assumed that retail prices move in line with these wholesale

prices. A copy of the type of questionnaire sent to retailers is given at Appendix 9.6.2.

Prices of new goods

9.6.24 The use of new goods as a proxy for old should be kept regularly under review to identify anything that might challenge the historic price relationship, for instance, where new safety regulations or environmental laws reduce the value of second-hand cars compared with new ones.

9.6.25 If the price trend of the corresponding new good is used as a proxy then the expenditure weight used in compiling the index must, of course, reflect expenditure on both new and second-hand goods. One approach is to include the weight of the second-hand good with that of the new good. Another would be to keep the second-hand item separate with its own weight and use it with the price index for the new good. The latter is, perhaps, more transparent.

Appendix 9.6.1: Example Price Collection Checklist for Second-Hand Clothing

Category: Second-hand Clothing

Product Name: **Men's Branded T-Shirt**

Product Code: 123.321

Preferred Quantity and Unit of Measurement:	1 Unit

Product Description:

- Product Presentation: No Package
- Quantity: 1 Unit
- Fibre Type: Cotton 100%
- Units per package: One
- Type: T-Shirt
- Brand/label category: Well known. Indicate. Not brand imitation.
- Sleeve Length: Short sleeve
- Fabric design: Single colour
- Neck style: Round neck

Collector:	.....
Date:	.....
Market:	.....

Product Detail *(✓or specify as appropriate)* :

Brand:		
Quality:	Perfect	
	Minor Wear and Tear(e.g. some fraying at edges)	
	Major Wear and Tear (e.g. some holes or major repairs)	
Fabric design:	Small logo	
	Large printed design	
	Multi-coloured fabric (e.g. stripes)	
Neck Style:	Round	
	V-neck	
Outlet Type:	Licensed outlet	
	Temporary stall	
	Street vendor	
Other Comments:		

Appendix 9.6.2: Example Price Collection Letter to Retailer

Bureau of Statistics
P.O Box 1

Date XX/XX/XX

Mr B Graham
Dealer, Second-Hand Clothes
Market A

CLOTHING PRICE INDEX

Every month the Bureau of Statistics collects clothing prices for the purpose of constructing the above mentioned Index and for this purpose we would request you to advise us on the following prices as at *insert date*.

We would remind you that it is important for you to let us know if the size of the bundles or the quality of the content has changed from the previous month. Any such changes should be recorded in the remarks column.

ITEM	TYPE	PREVIOUS PRICE PER BALE	CURRENT PRICE PER BALE	REMARKS
1. Shirt	Brand 1 (an international logo)	300		
	Brand 2 (a national brand)	350		
2. T-Shirt	Brand 1 (an international logo)	210		
	Brand 2 (a national brand)	200		
3. Women's Dress (Cotton)	Brand 1	400		
	Brand 2	425		
4. Men's Trousers (Cotton)	Brand 1	350		
	Brand 2	350		
.....				

CHAPTER 10

Index Calculation

Introduction

10.1 Chapter 9 of the ILO manual covers the calculation of consumer price indices including the elementary aggregates, the averaging of these using the relative values of the elementary aggregates as weights, to obtain higher-level indices, and the construction of the consumer price index itself from a weighted average of the higher-level indices. It provides a general description of the methods used and gives a general insight into the properties of the different index number formulae that can be used. This is supplemented by a detailed exposition of index number theory in Chapter 15 and on elementary indices in Chapter 20. The ILO manual points to the better statistical properties associated with the geometric mean whilst acknowledging that one of the few weaknesses of the geometric mean is that compared with an arithmetic mean it is much more responsive to large price drops.

10.2 Paragraphs 39 to 47 of the ILO resolution describe the different stages of index construction. The resolution advises against the use of the arithmetic mean of price relatives because this formula often produces biased results. Nevertheless, there is some scope for the use of the ratio of arithmetic mean prices particularly where the elementary aggregate is made up of relatively homogeneous items and the opportunity for substitution is limited. It recommends that the geometric mean be used particularly where there is a need to reflect substitution in the index or where there is a large dispersion in prices or price changes. The resolution is not prescriptive about whether a chained or direct index formula should be used in the computation of the elementary aggregate.

Background

10.3 The compilation of a consumer price index generally consists of two stages:

- The calculation of price indices for elementary aggregates. These so-called elementary indices are the lowest level of aggregation where prices are combined into price indices. It is often also the lowest level of aggregation for which explicit expenditure weights are available and used. Each elementary aggregate consists of a set of goods or services, usually from within a COICOP class, and are normally chosen to be as homogeneous as possible. The elementary aggregate can include stratification by region and by shop type (see chapter 5).
- The aggregation of these elementary price indices to higher level indices using relative levels of consumer expenditure as weights. At this stage, a Laspeyres-type index formula is typically chosen, thus reflecting the fact that for most price indices only basket reference period (as opposed to current period) weights are available. This explains why the CPI is often described as a fixed-weighted index or a fixed-basket index.

10.4 Accordingly, and using the arithmetic mean for purely illustrative purposes, the index $P_{t/0}$ in period *t* and which uses period *0* as the price reference period, is a Laspeyres-type or fixed base weight index, which can be expressed algebraically as:

$$P^{t/0} = \frac{\sum_i p_i^t q_i^b}{\sum_i p_i^0 q_i^b} \qquad (10.1)$$

where:

p_i^t = *price for* i^{th} *item (or product) at time t.*

p_i^0 = *price for* i^{th} *item (or product) at time 0, the price reference period (or base period)*[41].

q_i^b = *quantity of* i^{th} *item purchased during the weight (or basket) reference period.*

[41] For a CPI there are three kinds of reference periods: the weight reference period; the price reference period; the index reference period. See paragraph 9.81 of the CPI manual.

An algebraically equivalent expression for equation 10.1 is:

$$P^{t/0} = \frac{\sum_i \left(p_i^t / p_i^0\right) w_i}{\sum_i w_i} \quad (10.2)$$

where $w_i = p_i^0 q_i^b$

10.5 Expressed in this way, equation 10.2 represents the weighted average of elementary price indices $\left(p_i^t / p_i^0\right)$, in this case ratios of average prices i.e. they represent the weighted average of elementary price indices relating to each individual item *i*. The weights are the expenditure shares for item *i* in the basket reference period which is expressed at base period prices (i.e. hybrid expenditure weights). A price relative is the ratio of a product's price at a given point in time to its price at another point in time - in this particular case using average prices.

10.6 Formula 10.1 is not a "genuine" Laspeyres price index. For the CPI to be a Laspeyres index, the base period would have to coincide with time 0. But current period expenditure data are only available to the index compiler with a lag, sometimes as long as two years or more. Consequently, expenditure data for some previous period are used, usually drawn 12 or more months in the past and therefore the price reference and weight reference periods do not match.

10.7 The elementary aggregate forms the basic building block of a CPI and can have an impact on the overall index through its influence on the performance of different aggregation formulae, so the choice of elementary aggregate and the choice of formula used in aggregation can be of critical importance.

10.8 Operational and computational issues are also important considerations in the aggregation of elementary price indices to higher level indices. By the splicing and chaining approach, the weights can be changed as frequently as desired and is only limited by the availability of weighting information and the availability of operational resources. In the end, the CPI becomes a series of linked indices which are chained together thus ensuring the series' continuity.

10.9 This current chapter provides guidance both with regards to the calculation of price indices for elementary aggregates, and the aggregation of these elementary price indices into higher level indices all the way to the all-items CPI. The chapter is not directly concerned with the calculation of weights, nor in the design of the sample for price collection. These issues are addressed in chapters 4 and 5 respectively.

The compilation of indices for elementary aggregates

10.10 The price statistician is confronted with three issues in constructing the CPI:

- Lack of access to the prices for all products in the marketplace. Instead a sample of prices is collected (usually purposive i.e. non-probabilistic).
- Incomplete expenditure data at the lowest level of detail, so un-weighted elementary aggregates are calculated at the most basic level.
- Changes in the sample of prices occur within the elementary aggregate as a result of new and disappearing varieties.

10.11 Elementary aggregates are defined as the smallest aggregates for which reliable weights based on consumer expenditure data are available. The latter are used to aggregate the price indices for elementary aggregates to obtain higher-level indices. Elementary aggregates can also serve as strata for the sampling of prices.

10.12 The essential tasks of the index compiler in compiling the elementary indices are two-fold:

- To organise the large set of monthly price observations in a way that allows the calculation of price indices at detailed levels that are representative of the entire population of transactions during a given period.
- To calculate those indices in a way that gives the most accurate results, given that no weights are available at the most detailed levels.

10.13 In practice, elementary aggregates are composed primarily in terms of groups of homogeneous products but the decision in the short or medium term on what should be the lowest level of product definition for an elementary aggregate is governed mainly on the existence of weights. The reliability of the weights at these disaggregated levels may be variable - they may be based on survey data, or they may be estimated from other data sources such as administrative data. The important point to note is that for the purpose of index construction, no elementary aggregate should be created for which there is no reasonably reliable overall weight information. This means that some elementary aggregates may need to cover more than

one representative item. For instance the price statistician may not have weights for a representative item, such as bananas, let alone stratified by bananas sold in supermarkets versus other outlet types in each region. In such cases where lack of weights prevents the use of a more narrowly-based elementary aggregate it is important to construct the elementary aggregate to be as homogeneous as possible. For instance, in the northern hemisphere if it were not possible to construct an elementary aggregate for bananas an elementary aggregate for fresh tropical fruit would likely be better than an elementary aggregate for fresh fruit in general.

10.14 In the longer term, the availability of weights for CPI category should not be an exogenous constraint on the definition of elementary aggregates. The weighting information required to construct CPI baskets is something that should be negotiated with the officials responsible for household survey estimates or whatever other source is used to establish CPI basket shares.

10.15 Note also that the choice of products within the elementary aggregate will depend on the classification system being used. For instance, assuming that the international classification COICOP is adopted, then elementary aggregate products should fall within one of the COICOP classes, such as "garments" (COICOP 03.1.2). The decision on the number of elementary aggregates within the "garments" classification, will depend on the availability of expenditure weights. A typical choice may be whether to define separate elementary aggregates for: men's outerwear, men's underwear, women's outerwear, women's underwear, and children's clothing - or at some greater or lesser detail than this.

Homogeneity

10.16 What is meant by "homogeneity"? There are three main dimensions from the perspective of a CPI compiler. All three are related and the compiler should always attempt to maximise the homogeneity in the CPI sample.

- *Purpose*. The products should have a broadly similar purpose - using COICOP (which is a classification of products by purpose) should assist in ensuring this.
- *Prices*. Products should be selected in such a way that the price movements (and to a lesser extent price levels) are likely to be reasonably similar. This cannot always be achieved in practice and there is no guarantee that future price behaviour will be the same as previous price behaviour. For instance, where hand gloves are included in an elementary aggregate, it may be that the price trends of leather gloves may unexpectedly diverge from those of woollen gloves as a result of divergences in the costs of raw materials.
- *The potential for substitution*. The choice of products to include within an elementary aggregate should also account for the degree of substitutability in response to a change in relative prices. For example, an elementary aggregate defined as fruit may include apples and pears, if it is known that consumers regularly substitute one for the other as a reaction to changes in their respective prices. An aggregate for clothing would most certainly need to be divided into more narrowly defined elementary aggregates simply because many of its items are not considered close substitutes, e.g. hats and shirts. Substitutability also influences the choice of the most appropriate index formula to use in the construction of the index for the elementary aggregate. This issue will be discussed later in the section about index formulae.

10.17 Clearly, the more narrowly defined the elementary aggregate, the more homogeneous the products in the elementary aggregate should be. For example, an elementary aggregate for women's outerwear would include such products as blouses, dresses, skirts, hats, overcoats etc. The latter are quite different types of product, and may not be considered to be particularly homogeneous. An elementary aggregate just for women's dresses is likely to be much more homogeneous and is a more desirable goal if expenditure weights for such a grouping are available.

Selection of representative items

10.18 This is covered in Chapter 5, with additional advice on the related issue of price collection provided in Chapter 6, and the reader should refer to these chapters for a fuller discussion on the subject. Suffice it to note here that an elementary aggregate, such as women's outerwear, is usually disaggregated into a number of "representative items". This step is necessary since the level of product definition in a typical elementary aggregate is too broad to serve as a detailed specification for price collectors. For instance, a price collector cannot be expected simply to collect a price for "women's outerwear" - some examples of women's outerwear must be carefully specified. In doing so, a balance is struck between the cost of collecting, checking and processing the prices, against the practical difficulties that might be

Table 10.1 Example of stratification by region and outlet-type

	Region				
Outlet-type	**1**	**2**	**3**	**4**	**All regions**
A	**a**	**b**	**c**	**d**	
B	**e**	**f**	**g**	**h**	
All outlet types					

confronted in the field and the accuracy of the elementary aggregate index.

Stratification of elementary aggregates

10.19 As mentioned in Chapter 5, elementary aggregates are frequently defined in three dimensions - product, region and outlet-type. For example, there may be an elementary aggregate for razor blades in small independent shops in the Northern Region of a country.

10.20 Table 10.1 shows a simplified example which assumes, for an undefined product within an elementary aggregate, stratification by region and outlet-type.

10.21 In this example there are 4 regions: North, South, East and West. There are also two outlet-types: small independent shops, and other outlet-types - making a total of eight strata, each of which will be defined as an elementary aggregate. Note that it may not be possible in some countries to find the data necessary to have such a fine breakdown for a particular product while in some other countries such a detailed stratification may not be a necessary enhancement to the survey design. The table must be adapted and reduced according to a country's particular circumstances. The letters **a** to **h** represent the estimated expenditures in each stratum on the product concerned. In this example there are 4 regions, say North, South, East and West, and 2 outlet-types, say small independent shops and other outlet-types - making a total of 8 strata, each of which will be defined as an elementary aggregate.

Calculation formulae for elementary aggregate indices

10.22 The method of calculating the indices for the elementary aggregate is dictated by the availability of the weight information. For example, cell "a" in Table 10.1 refers to razor blades in small independent shops in the North Region. In any particular price collection period there will be a number of prices collected in order to populate this elementary aggregate. There may be several towns in the North Region covered in the CPI sample, and in each town there may be several small independent shops. In each small independent shop, collectors may be required to monitor the prices of two different types of razor blade – say, a well known universally available brand, such as Gillette, together with a local brand. In practice there may be, say, as many as 50 or more prices collected for elementary aggregate "a" each month (or as little as 3) but for illustration purposes Table 10.2 assumes that there are 14 prices.

10.23 To compile an index for universal brand (Gillette) razors in Shop 1 in Town A is straightforward – according to Table 10.2 there was no change in the index between months 1 and 2, while the index registered an 8% rise between months 2 and 3. To calculate an index for razor blades in small independent shops in the North region however, the index compiler is confronted with a choice of methods for aggregating the prices and thus calculating the elementary price index.

10.24 This chapter looks at the three main methods used by NSIs for calculating the elementary aggregates. Other methods are discussed in Chapter 9 of the Manual. It should be noted that selecting the correct formula is critical; otherwise this could have a significant impact on the overall CPI, thus undermining its reliability and credibility of the index.

10.25 The index compiler has three main aggregation methods to choose from for the

Table 10.2 Product: Razor blades in the North Region

		Prices		
Product	**Outlet-type**	**Month 1**	**Month 2**	**Month 3**
Universal brand (Gillette)	Town A Shop 1	25	25	27
Local brand	Town A Shop 1	12	12	13
Universal brand (Gillette)	Town A Shop 2	27	27	27
Local brand	Town A Shop 2	14	15	15
Universal brand (Gillette)	Town A Shop 3	18	18	20
Local brand	Town A Shop 3	10	10	10
Universal brand (Gillette)	Town B Shop 1	26	25	26
Local brand	Town B Shop 1	12	12	12
Universal brand (Gillette)	Town B Shop 2	28	29	29
Local brand	Town B Shop 2	17	17	17
Universal brand (Gillette)	Town C Shop 1	19	19	19
Local brand	Town C Shop 1	10	11	11
Universal brand (Gillette)	Town C Shop 2	21	20	22
Local brand	Town C Shop 2	12	12	13
Arithmetic mean		*17.93*	*18.00*	*18.64*
Arithmetic mean of price relatives (current month over previous month)		*N/A*	*1.01*	*1.04*
Geometric mean		*16.82*	*16.96*	*17.54*

construction of the elementary aggregate price indices of a consumer price index.

- The ratio of the arithmetic mean of prices (or *Dutot* index). This is often referred to as the ratio of averages (RA). Referring to Table 10.2, the compiler takes the arithmetic mean of all the prices in month 1 (17.93) and compares it with the arithmetic mean of all prices in month 2 (18.00). The ratio of these two means is 1.004 (i.e. an index increase of 0.40%).
- The arithmetic mean of price relatives (or *Carli* index). This is often referred to as the average of relatives (AR). The compiler calculates each of the 14 price ratios (or price relatives), from month 1 to month 2, and takes the arithmetic mean of all the ratios. Again using the price data given in Table 10.2, this gives an index rise of 0.86% - twice the estimate obtained with the average of relatives.
- The ratio of the geometric mean of prices (GM) (or *Jevons* index). The compiler carries out similar calculations to the ratio of averages and the average of relatives but using geometric rather than arithmetic means. This is done by taking the 14th root of the product of all 14 prices or price ratios, thus generating an index rise of 0.80% in both cases.

10.26 In many countries, prices for at least some products are collected more than once a month. Petrol is a good example where the prices are often quite volatile and its weight relatively large. It is inappropriate to use these individual prices in the calculation of the price index for the elementary aggregate as this will imbalance the sample of price quotations. Instead the prices should be averaged before use in compiling the elementary price index. For a monthly CPI, it is usually sufficient to take a simple arithmetic average of the price quotes for each specific item in each specific shop to obtain a representative (monthly average) price for use in compiling the elementary price index. This strategy is also more transparent for the users. Using a geometric average of the intra-month price observations should best be avoided however. It can be shown that when calculating the mean of two extreme values, say 0.001 and 0.990, that the arithmetic mean (0.49505) provides a more credible result for the representative price than that obtained with the geometric mean (0.004987).[42] Note that

[42] This follows from Schlömilch inequality.

using the arithmetic mean formula for averaging the intra-monthly price observations, should not affect the compilers decision as to the formula to use for constructing the elementary price indices, which is separate issue (i.e., Jevons, Dutot, or Carli – See the Choice of Formula later in this chapter).

Implicit weights within an elementary aggregate – replication

10.27 Although the lack of explicit weights below the elementary aggregate level means that the expenditures in Table 10.1 cannot be further subdivided, implicit weights within an elementary aggregate, through the replication of price quotes, provides a further way of improving the accuracy of the elementary aggregate indices. For instance, it may be known, from simple observation, that Town A Shop 1 is much larger and has a higher sales volume than Town A Shops 2 and 3. Therefore, it would seem logical to give more weight to the price changes in Shop 1 than to those in Shop 2, rather than the equal weighting given by the three aggregation methods shown above. This can be done through the method known as "replication". Effectively, the method gives a larger weight to Shop 1 than the other shops in Town A. The allocation of a weight by replication can only be done by informed guesswork, because no data is available on the sales of razor blades in different outlets. For example, it might be observed that Shop 1 is about 3 times larger than the others on the basis of numbers of staff employed or on total shop area. In such a case the prices recorded in Shop A could be replicated three times. Thus, the first two rows in Table 2 would be each repeated twice. This replication does not need to be done explicitly. The formula used to calculate the means can easily be adapted to include the prices in the first two rows three times instead of just once as for the others.

10.28 In this example, the results for the three methods described above would be 0.31%, 0.67% and 0.62% (compared with 0.40%, 0.86% and 0.80% respectively). The replication makes a significant difference in this example, as would be expected. But such an approach should be exercised with some caution. The index compiler needs to be aware of the potential for replication to introduce bias into the index if for some reason an unrepresentative price is replicated. For instance, if the price of one razor blade is recorded in a very large supermarket and replicated a factor of one hundred, while this particular razor happens to be unrepresentative and because of low sales volume it is offered at a discounted price then replication will bias the index downwards.[43]

10.29 The alternative and technically preferred option to replication is to select outlets in proportion to their estimated size (turnover). Thus, in the above example, for each supermarket as large as Town A Shop 1, the sample would include three of the smaller types of supermarket. However, this may not be practicable, and the additional price collection costs may not be justified. Also the same judgments about relative size are involved. But this overcomes the potential bias associated with replication of an unrepresentative price quote and also has the advantage that the effective replication factor can vary according to product.

Choice of formula

10.30 As already indicated there are three main aggregation methods for the construction of the elementary aggregates of a consumer price index.

- The ratio of the arithmetic mean of prices (or *Dutot* index). This is often referred to as the ratio of averages (RA).
- The arithmetic mean of price relatives (or *Carli* index). This is often referred to as the average of relatives (AR).
- The ratio of the geometric mean of prices (GM) (or *Jevons* index);

10.31 These aggregations can be expressed algebraically as follows:

$$\text{RA: } I^{t/0} = \frac{\sum_i p_i^t / n}{\sum_i p_i^0 / n} \qquad (10.3)$$

$$\text{AR: } I^{t/0} = \frac{\sum_i p_i^t / p_i^0}{n} \qquad (10.4)$$

$$\text{GM: } I^{t/0} = \left(\prod_i \frac{p_i^t}{p_i^0} \right)^{1/n} = \frac{\left(\prod_i p_i^t \right)^{1/n}}{\left(\prod_i p_i^0 \right)^{1/n}} \qquad (10.5)$$

where prices p_1^0 to p_n^0 are obtained in the base period and matching prices p_1^1 to p_n^1 are obtained for the same commodities in a subsequent month t.

[43] The calculation system could be designed to allow for the use of explicit weights, which would be essentially the same as replication.

10.32 The CPI Manual (see paragraphs 9.25 to 9.38) includes a detailed discussion of the underlying economic assumptions and properties of these and other formulae. Only a short summary of the most salient points is given in the following sub-sections of this chapter.

The economic theory and market assumptions behind each formula

10.33 In theory a price index can be compiled for each individual product by computing the price relative:

$$\frac{p_i^t}{p_i^0}$$

i.e. the ratio of the price in month *t* to the price in the base month 0. A weighted average of all price relatives is then calculated using relative expenditures on each individual product. This can be expressed by the following generalised formulae:

$$P^{t/0} = \sum_i w_i \frac{p_i^t}{p_i^0} \qquad (10.6)$$

where the weights have been normalised, i.e. where the weights sum to one, one hundred or a thousand and reflect the relative importance of products 1 to *n* in the consumer's budget.

10.34 It follows that:

- If all weights are equal then the generalised formula becomes AR. Thus AR is most appropriate if each price quote within the elementary aggregate is considered to be equally important, i.e. if each price quote represents the same expenditure share and this expenditure share doesn't change over time with relative changes in prices. It can be noted that in the context of a chained index AR is not really consistent with the economic approach to index numbers[44].
- If the weights are proportional to the base price, so that equal quantities are purchased of each product in the base period (corresponding to each price quote) and these same quantities are purchased in subsequent periods, then the generalised formula becomes RA. Thus RA is most appropriate if the base price reflects the relative importance of each price quote and the quantities purchased remain the same, i.e. they are not influenced by subsequent price movements. Under these conditions, the Laspeyres price index remains the "appropriate" economic price index and RA can be justified in a fixed base situation provided that equal quantities are purchased in the base period.
- The GM assumes equal expenditure weights that are constant over time. This is true both in a fixed base or chained context.

10.35 Thus the appropriateness of a particular formula depends on the assumptions made about consumer behaviour. The Jevons index is strictly speaking not a fixed basket index, since the quantities are assumed to vary over time in response to changes in relative prices. As a result of the inverse relation of movements in prices and quantities the expenditure shares are constant over time. Carli and Dutot, on the other hand, keep the quantities fixed while the expenditure shares vary in response to change in relative prices.

- The assumption of equal expenditure weights underlying the geometric mean (Jeavons) infers that changes in relative prices within an elementary aggregate will result in proportionate and opposite changes in the relative quantities sold. The Jevons formula will provide a closer approximation to a cost-of-living index where there is likely to be a significant amount of substitution within the elementary aggregate. The Carli formulation keeps the quantities fixed while the expenditure shares vary in response to change in relative prices. If the relative quantities remain constant, then the Carli index can be expected to provide a good estimate of a cost-of-living index.

10.36 The Dutot formulation also keeps the quantities fixed while the expenditure shares vary in response to change in relative prices and may be preferred provided the elementary aggregate consists of homogenous products. In practice, for most goods and services, the elasticity of substitution tends to be neither 0 nor 1. It usually lies somewhere between 0 and 1 or can even be in some cases larger than 1.

[44] AR is appropriate for a chained index if each price quote represents the same base period expenditure share expenditure shares remain constant over time. But, if expenditures shares remain constant over time in the face of arbitrary fluctuations in prices, preferences must be Cobb Douglas and the fixed basket type index that corresponds to AR is not appropriate: a geometric Jevons type index would be the appropriate index with constant expenditure shares.

Some axiomatic properties

10.37 The axiomatic approach to index numbers attempts to determine the most appropriate formula to apply by reference to specific axioms or tests that the index ought to ideally satisfy. Paragraphs 1.53 to 1.84 of the ILO Manual discuss these in some detail and this is supplemented by further material in Chapter 16. Three of the more critical axioms or tests – the "time reversal" test, the "commensurability" test and the "transitivity" test – are considered here together with the issue of zero prices.

- The *Carli* formula, or AR, fails the "time reversal" test. If prices in period 2 revert to the initial prices in period 0, then the product of the price change going from period 0 to 1, times the change going from period 1 to 2, should be unity - i.e. the index should end up where it started. This does not happen with the Carli index: in fact, unless the prices in the two periods are exactly proportional, the product of the two Carli indices will end up being greater than one, with the result that there is potential for upward bias when the Carli formula is used. The Carli also does not satisfy the "transitivity" test – the chain index between two periods does not equal the direct index between the same two periods, indicating the potential for in-built bias.
- The *Dutot* formula, or RA, does not suffer from the same defects as Carli. But it has other disadvantages. If the elementary aggregate includes products which have widely differing price levels, the products which are more expensive (in the chosen units of measurement) will get a larger implicit weight, and hence have a greater influence on the elementary aggregate index. A further complication is that the Dutot formula is accurate only if all the constituent products are measured in the same units (i.e. it fails the so-called commensurability test). This is an important result, and the table below illustrates the effect, using an imaginary elementary aggregate called "seasonings", comprising two representative items, salt and pepper. In most countries pepper is much more expensive than salt if measured by weight, though in practice much less pepper is consumed than salt. Table 10.3 shows an extreme example of both of the above defects.
- Being multiplicative, the *Jevons* formula cannot use a price of zero. This is not always listed as an axiom but it is nonetheless important to bear in

Table 10.3 Elementary Aggregate: "Seasonings"

	MONTH			
	1	2	Month2/Month1	
A) DIFFERENT UNITS	**Price**	**Price**	**Price ratio**	
Pepper (10g)	2.70	3.80	1.407	
Salt (kg)	2.50	2.70	1.080	
Arithmetic mean prices	2.60	3.25	**1.250**	DUTOT
Geometric mean prices	2.60	3.20	**1.233**	JEVONS
Arithmetic mean of ratios			**1.244**	CARLI
Geometric mean of ratios			**1.233**	JEVONS
B) SAME UNITS				
Pepper (kg)	2700	3800	1.407	
Salt (kg)	2.50	2.70	1.080	
Arithmetic mean prices	1351.25	1901.35	**1.407**	DUTOT
Geometric mean prices	82.16	101.29	**1.233**	JEVONS
Arithmetic mean of ratios			**1.244**	CARLI
Geometric mean of ratios			**1.233**	JEVONS

mind. Zero prices may happen if the price of a product (for example. a government service within education, health or transport) changes from zero to a positive price, or vice versa. In such cases, a possible solution is to combine the item concerned with a related item, and first to calculate an average price of the two items before applying the Jevons formula. The treatment of the incorporation into an index of services previously provided free is covered in Chapter 8.

10.38 To summarise the above discussion, it follows that:

- The *Dutot* formula should be used only where the products are homogeneous and where consumers have only limited opportunities to substitute between products or where the policy is that substitution is not to be reflected in the CPI.
- The *Carli* formula is to be avoided because of the potential for bias, particularly in its chained form. The formula fails the time reversal and transitivity tests and gives more importance to prices that rise more quickly.
- The *Jevons* formula avoids the problems associated with the Dutot and Carli formulas and is generally regarded to be the most preferable method technically for calculating elementary aggregates. It also implicitly assumes that consumers substitute between products when their relative prices change (a realistic assumption in many cases), although with an elasticity of substitution of one it may overstate the impact. The Jevons formula is particularly appropriate where there is a need to reflect substitution in the index or where there is a large dispersion in price levels or changes. It is generally the more favoured method worldwide for compiling a CPI particularly as it is arithmetically well-behaved and stable, not being prone to influence from differences in the statistical variance in price levels and trends between elementary aggregates.

Implications for construction of elementary aggregates and sample stratification

10.39 The statistical design underlying the construction of the price index and its elementary aggregates should take into account the axiomatic properties of the different aggregation formulae. The main points can be summarised as follows:

- *Elementary aggregates*. The numerical differences between the various formulae tend to increase with the dispersion of the price relatives, so it is desirable to construct the elementary aggregates to minimise the variation in the price movements within each homogeneous elementary aggregate. The less variation there is in the price movements the less difference the choice of index formula will make numerically. But the index compiler needs to avoid the potential for bias due to the item definition being too narrow and excluding important parts of the market.
- As RA gives more weight to the price relatives for the products with high prices in the base period the construction of elementary aggregates should also avoid relative large price dispersions in the base period. This is because of the difficulty in providing an economic rationale for such implicit weighting. If the products in the elementary aggregate are homogeneous very few quantities will be purchased at high prices if the same products can be purchased cheaply either at a different retail outlet or under a different brand name. An elementary aggregate compiled using RA is not invariant to changes in the units of measurement of the individual products. Thus an RA index of energy products would change if the units of measurement for petrol changed from gallons to litres while leaving the units of measurement for natural gas consumption unchanged. Units of measurement for many commodities are basically arbitrary. It should therefore not be used for heterogeneous products where such variations can occur, including, for instance, pack sizes.
- *Sample stratification* As the elementary aggregates also serve as strata for sampling purposes, minimising the variance in the price relatives within the strata will also reduce the sampling error. This is often achieved by additional sample stratification, for example, by introducing further elementary aggregates by geographical location and outlet type but this assumes that the corresponding weights, which might requires a bigger and more expensive household budget survey, are available.
- *Item descriptions*. Item specifications may be generic or very precise. The approach adopted will depend on local circumstances and may consist of a mixture of both generic and specific item descriptions but it should be noted that the use of generic item descriptions is likely to increase the variance in prices. Where generic item descriptions are used for sample selection, price collectors should record detailed descriptions of the items being priced.

10.40 Further advice on Sampling is given in Chapter 5.

The compilation of upper-level aggregate indices

10.41 The previous sections explored the aggregation of prices at the lower-level to construct price indices for the elementary aggregates which are then weighted together to compute the all-items CPI, and any intermediate aggregate price indices at Class, Group, and Division levels, in the CPI scheme.

10.42 This section covers the compilation of upper-level aggregation, otherwise known as macro-indices. The topic is covered in detail in paragraphs 9.74 to 9.126 and 9.131 to 9.138 of the CPI Manual. This section provides a summary with some supporting examples.

The choice of index formula

10.43 Higher-level price indices are constructed as weighted averages of elementary aggregate indices. When compiling the upper-level indices by aggregating the elementary aggregates or the micro-indices, the compiler faces similar choices with regards to which index formula to use as in the case of micro-indices. These various formulae differ in terms of the information content of the weighting system used to compile index values.

10.44 In principle, the choice of index formula used to calculate a CPI should be determined by the "target" index that the statistical agency has set as its objective. For instance, in theory one of the superlative index number formulas, that passes the time reversal test, and is an average of the Laspeyres and Paasche formulas (e.g. Fisher formula) or a fixed-basket formula whose basket is an average of the base and given period baskets (Walsh, Edgeworth-Marshall or Törnqvist indices) should be used for the construction of a consumer price index[45]. However, in practice the compiler often lacks sufficient and timely knowledge about the prices and the quantities in both periods of comparisons to produce such indices. Consequently, statistical agencies will aim for a more modest but practical basket formula that is less data intensive; such a formula nevertheless provides valuable and timely insight as to the behaviour of prices in the economy.

10.45 Most of what follows focuses on constructing macro level indices using the class of fixed-basket formula most if not all statistical agencies use to construct their CPI.

The Laspeyres Index and the Laspeyres-type Index

10.46 In many references in the literature to the CPI formula, it is often mentioned that it is a Laspeyres price index. This is not most often an accurate depiction of the formula. For a CPI to be a "true" or "genuine" Laspeyres price index the weight reference period must coincide with time *b* and then the following weighted aggregative formulation would result:

$$P_{LA}^{t/b} = \frac{\sum_i p_i^t q_i^b}{\sum_i p_i^b q_i^b} \qquad (10.7)$$

where:
i is the number of products in the index basket.
p_i^b *is the price of the ith product at period b, the base or reference period.*
p_i^t *is the price of the ith product at period t (t > 0).*
q_i^b *is the quantity of the ith product at period b, the base or reference period.*
$P_{LA}^{t/b}$ *is the Laspeyres price index that measures the change in the aggregate value between the base period and period t for a given pre-defined basket,* q_i^b *of goods and services; the basket is re-valued in each period in terms of the prices of that period.*

10.47 A "true" Laspeyres price index where the base period coincides with time *b*, is rarely a practical option when what is needed is a timely CPI, which is available to users on an on-going basis. Some of the difficulties associated with applying the "true" Laspeyres formula for the CPI are:

- If expenditures for some products are characterised by a seasonal pattern, then the expenditure at time *b*, a sub-annual period, may be unrepresentative of the expenditures at other periods.
- Expenditure data for periods less than a full year are often unreliable.
- The reference period for the expenditure data are not in sync with the chosen basket update period[46].

[45] See, for example, ILO Manual paragraphs 15.18 to 15.23 for averages of the Laspeyres and Paasche formulas, and paragraphs 15.24-15.32 for the desirable Lowe formulas.

[46] Although, this dilemma could also be resolved were the CPI revisable. A CPI series could be recalculated using the new weights from the weight reference period using as the base prices those from the same reference period.

10.48 Price updating of expenditure weights provides a popular solution to the issue raised in the last point (to be discussed in a later sub-section). Once the weights are price-updated, the resulting price index is more in line with what is commonly recognised as a Lowe index (or Laspeyres-type price index). Most statistical agencies will use this index formula for compiling their CPI.

10.49 The Lowe price index formula, ($P_{Lo}^{t/0}$) which compares prices in period *t* to those in the price reference period 0, is written as:

$$P_{Lo}^{t/0} = \frac{\sum_i p_i^t q^b}{\sum_i p_i^0 q^b} \qquad (10.8)$$

where:

p_i^t *is the price of product i in period t*

p_i^0 *is the price of the same product in period 0, the price reference period for this index.*

q_i^b *is the quantity of product i which is representative for the two periods being compared (in practice, it will be the quantity that corresponds to a period that is prior to periods 0 and 1).*

10.50 The Lowe Index is, in some respects, a generic formulation. The basket associated with the Lowe Index does not have to be restricted to the quantities purchased in one or other of the two periods compared. The statistical agency has to make a choice of formula and most opt to compile this Laspeyres-type index.

Sampling and the use of expenditures rather than quantities: transforming the Laspeyres formulation to accommodate expenditure data from a Household Budget Survey or the National Accounts

10.51 The following formula represents how in practice a CPI compiler calculates the higher-level indices – as expenditure share weighted arithmetic averages of the elementary indices.

$$P^{t/0} = \sum_i w_i^b \frac{p_i^t}{p_i^0}, \sum_i w_i^b = 1 \qquad (10.9)$$

10.52 An issue arises relating to quantity versus expenditure weights. A typical Household Budget Survey does not solicit information from a household about the "quantities" of a commodity that it has purchased. The survey is designed to produce value aggregates associated with the consumption expenditures of a product. For instance, the survey does not ask the household "how many" candles were purchased during the reference period but rather enquires as to "how much" did it spend on candles[47]. Using value weights as opposed to quantity weights in the compilation of the CPI is also much more convenient because for some products, particularly some services, no tractable quantities, *q*'s (or unit values) are available. For example, property taxes, public transportation, and education tuition fees are good examples where the price statistician cannot derive meaningful unit values or quantity weights. Formula 10.9 can be transformed to account for these issues.

10.53 An equivalent algebraic transformation of formula 10.9 is:

$$P_{LO}^{t/b} = \sum_i \frac{p_i^t}{p_i^0} \frac{p_i^0 q_i^b}{\sum_i p_i^0 q_i^b} \qquad (10.10)$$

10.54 The expression $\frac{p_i^0 q_i^b}{\sum_i p_i^0 q_i^b}$ represents, the basket share of product (or elementary aggregate) *i* in the basket of goods and services that comprises the CPI. It can be expressed as 'parts-per-1000' or 'parts-per-100' the choice is really up to the compiler and either method will yield the same result.

10.55 To simplify the presentation and by setting $w_i = p_i^0 q_i^b$, formula 10.10 can be expressed as:

$$P_{LO}^{t/0} = \sum_i \frac{p_i^t}{p_i^0} \frac{w_i}{\sum_i w_i} \qquad (10.11)$$

10.56 With equation 10.11, the index is interpreted as the arithmetic average of the elementary price indices between two periods for a given set of goods and services covered by the index. The elementary price index p_i^t / p_i^b is the ratio of the average price of a product or product group *i* in the current period, *t*, to its average price in the price reference (base)

[47] In some countries a separate food expenditure survey is conducted in addition to the Household Budget Survey. Some dedicated food surveys will enquire about the volume of certain food items that are purchased such the number of kilograms of carrots or apples. This information can be very useful in calculating monthly basket shares for seasonal food products (See Chapter 9.5). The monthly profile of purchases of a good can be calculated directly from the monthly volumes and the annual unit price as well as indirectly by deflating monthly expenditures by the CPI for the good. In fact, if a price history does not exist for the good, as might be the case for a food product just being introduced to the CPI, the indirect calculation of monthly expenditures at constant prices may be the only option available. This information is often used to satisfy some particular needs of certain users but is not used in the calculation of the CPI.

period, *b* (i.e. the average of the price relatives[48]). An index using equation 10.11 shows unambiguously that a composite price index such as the CPI is a measure of price change. This formula, which is recognised as the *weighted average-of-relatives* can be computed in much the same way as a simple average of relatives but this time it is a weighted average. Expressing the price index as a weighted average-of-relatives does have other advantages over the aggregative indices, for instance:

- The price relatives for each individual product or product group in the aggregate together constitute a simple product or product group price index that often provides valuable analytical information.
- When a new commodity is introduced to replace one that was formerly included, the relative for the new item may be chain-linked to the relative for the old one, using the existing value weights. The chain-linked index will retain its existing value weight.
- Values rather than quantities are used in order to produce weighted relatives that are all in the same monetary units which can be aggregated; generally, quantities cannot be directly employed as weights, although in some cases they may be, that is they may be applied in the calculation of some elementary indices.
- The basket reference period for an index is usually a year, but in extremis may be less.
- Different elementary aggregates can be combined, provided they have the same base year, to form new special aggregate indices that users sometimes request.

10.57 Note that weights, w_i of the individual products that are used in formula 10.11 are defined as "hybrid" weights that have been price updated from the basket reference period. (The practice of price updating is discussed in the next section.) These weights represent the cost of buying the quantity of commodity *i*, derived from the basket reference period, q_i^b but re-valued at prices from some chosen base period, p_i^0 .

10.58 An issue worthy of special mention is with regards to the prices that are used in the compilation of the index with equation 10.11 or any other formulation for that matter. The *p* appearing in the formula is not the price associated with an individually specified item or variety such as those selected from outlets every month for the CPI. Instead, these prices would more accurately be described as an estimate of the price of a group or sample of products that make up the elementary index aggregate. In other words, p_i is more precisely defined as a $\hat{p}_i$, an estimate of the prices of sampled products within the stratum of the elementary index. These are average prices, based on a sample associated with the individual product groups at the lowest level of aggregation for which reliable expenditure weights are available, i.e. the elementary aggregates. In most cases no one single price will in fact make up an elementary aggregate except in exceptional cases where an elementary aggregate is represented by a single item such as the domestic postal rate established by the national postal office for first class mail.

10.59 To summarise the discussion so far, the target index is normally the Laspeyres price index, a specific form of a Lowe Index. In practice however, because of the non-revision policy of most CPIs and the need for timeliness, a chain Lowe (Laspeyres-type) index formula is usually the chosen option by the statistical agencies for calculating their CPI. A Laspeyres-type index is easy to explain and understand as it answers the question how much more or less does it cost to purchase the same basket of goods and services over an interval of time (e.g., a month, a year or many years). But it is not without it problems and may be seen as a practical compromise which departs from the ideal.

Time-lags and the use of price update hybrid weights in a Laspeyres-type Index

10.60 As previously mentioned, the price reference and weight reference periods coincide in the formulation of the true Laspeyres price index. Formula 10.12 shows the Laspeyres price index from 10.8 transformed to weighted "average of relatives" equivalent.

$$P_{LA}^{t/b} = \sum_i \frac{p_i^t}{p_i^b} \frac{p_i^b q_i^b}{\sum_i p_i^b q_i^b} \qquad (10.12)$$

10.61 Here, according to the true Laspeyres formula, p_i^b is used as the price used for estimating the value of the weights in the basket reference period, *b* and also as the base period price. Indeed, $p_i^b q_i^b$ is derived directly and is the observed actual

[48] The expression "price relative" should not be confused with another common term used in economics, which is "relative price". While a price relative is the ratio of two prices of the same product taken at two distinct periods in time, a relative price is the ratio of the prices of two different products at the same point in the time and is meant to measure how much more or less the price of product A is compared to that of product B.

value (as opposed to hybrid value) of a commodity in the basket reference period *b*. Recall, that these observed values are derived from Household Budget Surveys (HBS) or/and the National Accounts, or possibly other sources.

10.62 In practice, the price base period and the basket reference period will diverge because of an unavoidable lag associated with processing the weight data, a necessary exercise regardless of their source, e.g., HBS or National Accounts. To ensure that a commodity's weight and its price share a common period, the weight is price updated (or adjusted) from its reference period to the price reference period.

10.63 Weights commonly used in a CPI are not therefore the observed weights from their reference period but can best be described as hybrid (or price-updated) weights. Price updating of weights, an often necessary practice, should however be exercised with a certain level of care[49].

10.64 Multiplying the reference period expenditure for that commodity $p_i^b q_i^b$ by its corresponding elementary index for period *b* to period *0*, will yield that commodity's price-updated hybrid weight.

$$w = \left(p_i^b q_i^b\right) \times \frac{p_i^0}{p_i^b} = p_i^0 q_i^b \qquad (10.13)$$

Where:

$p_i^b q_i^b$ *: The observed expenditure value for a given product at the basket reference period.*

p_i^0 / p_i^b *: The price index for the product that compares its price in the base period, b to its price during the basket reference period.*

w *: The hybrid value weight (expenditure) for the product or product group (i.e. the elementary aggregate), which is used for weighting the price relatives. It represents the hypothetical cost of buying the quantity* q_i^b *of a single product or product group n drawn from the basket reference period b at its base year price,* p_i^0 *.*

10.65 Given the set of price-updated weights, the formula for calculating the CPI from period 0 to period *t* can now be written as follows:

$$P_{LO}^{t/0} = \sum_i \frac{p_i^t}{p_i^0} \frac{p_i^0 q_i^b}{\sum_i p_i^0 q_i^b} \qquad (10.14)$$

Where $p_i^0 q_i^b$ *is the hybrid value weight (expenditure), and*

$\frac{p_i^0 q_i^b}{\sum_i p_i^0 q_i^b}$ *is the basket share for the i th commodity in terms of period b expenditures at period 0 prices. The sum of these shares must be rescaled so as to equal 1 (or 100) at the new time base which is often, but not necessarily, chosen to coincide with the new price reference period, 0.*

10.66 Note that equation 10.14 is not a true Laspeyres price index but is instead a Lowe price index because the timing of the price reference period (typically a month), p_i^0 now differs from the weight reference period (typically a year).

10.67 Equation 10.14 may conceal the subtle nature of the price updating exercise. For this reason, a simple algebraic example is presented here.

10.68 Consider a situation where the weight reference period relates to the year 2001 and the objective is to calculate the CPI for December 2002 (the link period) to April 2007. The index would then be calculated as follows:

$$P_{LO}^{April07/Dec02} = \sum_i \frac{p_i^{April07} q_i^{01}}{p_i^{Dec02} q_i^{01}}$$

$$= \sum_i \left[\frac{\left(p_i^{01} q_i^{01}\right) p_i^{Dec02} / p_i^{01}}{\sum_i \left(p_i^{01} q_i^{01}\right) p_i^{Dec02} / p_i^{01}} \right] \frac{p_i^{April07}}{p_i^{Dec02}}$$

$$= \sum_i \left[w_i^{Dec02\langle 01 \rangle} \right] \frac{p_i^{April07}}{p_i^{Dec02}}$$

Where:

p_i^{Dec02} / p_i^{01} *is the price index for product i that compares its price in December 2002 against its price level in 2001.*

$p_i^{April07} / p_i^{Dec02}$ *is the price index for product i that compares its price in June 2007 with its corresponding price in December 2002.*

$w_i^{Dec02(01)}$ *is the reference period weight from 2001 (the 12-month period) that is price updated to December 2002 and will be applied to the price relative of product i.*

10.69 The price index p_i^{Dec02} / p_i^{01} represents the price of a product (or commodity) in December 2002 compared to its average price in 2001. Where price relatives are calculated as month-to-month ratios in the course of CPI production, some algebraic

[49] See Chapter 4.

transformations are required to arrive at this particular price relative. These are briefly described here.

Step 1

10.70 Take the average of the 12 monthly price indices in 2001 that have been generated using, for the purpose of this example, price base period drawn from 1992.

$$\frac{\left(\frac{p_i^{Jan01}}{p_i^{92}}+\frac{p_i^{Feb01}}{p_i^{92}}+\cdots+\frac{p_i^{Dec01}}{p_i^{92}}\right)}{12}=\frac{p_i^{01}}{p_i^{92}}$$

10.71 The resulting index can be interpreted as the change in 2001 prices compared to their level in the price base period, 1992.

Step 2

10.72 Multiply the value obtained in step 1 by the reciprocal of the December 2002 index estimated at the 1992 time base.

$$\frac{p_i^{01}}{p_i^{92}}\times\frac{1}{\frac{p_i^{Dec02}}{p_i^{92}}}=\frac{p_i^{01}}{p_i^{Dec02}}$$

Step 3

10.73 Taking the reciprocal of $\frac{p_i^{01}}{p_i^{Dec02}}$ will yield the relevant price index, $\frac{p_i^{Dec02}}{p_i^{01}}$.

10.74 The April 2007 index in this simplified example is calculated with price-updated weights which estimate the value of consumption in 2001 re-valued at April 2007 prices compared to the value of that same 2001 consumption bundle but estimated at December 2002 prices.

Chain-link method: operationally more convenient

10.75 When calculating the CPI, the index compiler has a choice between using long term elementary indices and constant weights as in (10.16) or price-updated weights and monthly elementary indices as in (10.17). All things being equal, they give the same result, but as also mentioned the use of monthly chained elementary indices has several practical advantages. Note, there is no need to programme the system to price-update the weights, as the compiler has the same advantages simply by calculating the elementary indices as chained monthly indices and weight these together with the constant weights.

$$P^{t/0}=\sum w_i^b P_i^{t-1/0}P_i^{t/t-1},\sum w_i^b=1 \qquad (10.15)$$

10.76 Formula 10.15 is the formula for a Young index and it can be seen that it has the same form as a weighted Carli index. It can be shown that this formula produces an index with an upward bias. However, studies have shown that the Lowe formula can generate an index with an even larger upward bias than the corresponding Young index. Consequently, statistical offices are encouraged to minimise any delay in introducing a new basket (or set of newly surveyed expenditure data) thus minimising the time between the weight reference period and price reference period. This practice will ensure that the potential for bias from using either a Young or Lowe index formula is minimised. It should be noted that many statistical offices use the Lowe formula because of its ease of interpretation as a fixed basket index. Price updating is not, however, a substitute for updating the basket weights with more frequent expenditure surveys or from other sources of weight information.[50]

10.77 When producing a price index such as the CPI on an on-going basis, it can be operationally more convenient to update the current month's index using month-to-month price relatives as opposed to using long term relatives (current month's price compared to its corresponding base price). Note that to measure price change between period t + 1 and period 0 (t + 1 > 0) using formula 10.14 would result in the following direct index:

$$P_{LO}^{t+1/0}=\sum_i\frac{p_i^{t+1}q_i^b}{p_i^0q_i^b}=\sum_i\frac{p_i^{t+1}}{p_i^0}\times w_i \qquad (10.16)$$

10.78 Recall that w_i is a hybrid weight. However, most countries do not use equation 10.14 per se to calculate their CPI. A more operationally convenient variant is often used instead. This is the "procedural" monthly *chain-link* method, which can be calculated for period t as follows:

$$P_{LO}^{t/0}=\sum_i\frac{p_i^tq_i^b}{p_i^0q_i^b}=\sum_i\frac{p_i^t}{p_i^{t-1}}\frac{p_i^{t-1}q_i^b}{\sum_i p_i^0q_i^b} \qquad (10.17)$$

where the usual conventions apply for the notation.

Note that formula 10.17 is equivalent to formula 10.14.

[50] It is likely that the geometric Young formula produces the least bias for an index that uses reference weights from distant years.

10.79 Note that the long term Lowe index going from month 0 to $t-1$ can be written as a sum of terms of the form $p_i^{t-1}q_i^b / \sum_i p_i^0 q_i^b$. The Lowe index going from month 0 to month t can be written as the sum of the short term elementary indices going from period $t-1$ to t, p_i^t / p_i^{t-1}, multiplied by $p_i^{t-1}q_i^b / \sum_i p_i^0 q_i^b$. The important feature of this approach to calculating the index for period t is that this index can be readily calculated by simply updating the previous month's index by the short term elementary indices.

10.80 Calculating the index using formula 10.17 has two significant advantages over a formula similar to 10.16, from an operational point of view.

- The short term relative procedure offers more latitude to the compiler for dealing with new and disappearing products, missing prices, and quality adjustments. In other words, the sample of products within an elementary aggregate can be different in period t+1 to t from those in the interval 0 to t. Items can be replaced or introduced into the index by linking at period $t-1$ thus avoiding the need to estimate a price at period 0. For example, suppose that the in month t+1 a certain model car is subject to a quality change over the previous month's (t) model. With formula 10.17, the compiler does not adjust the current period's price of the car but the previous period's price. If the current price were targeted for adjustment, then all subsequent prices would also have to carry the adjustment to ensure that the index shows no movement during the later periods as a result of this specific quality change. This is a tedious exercise that can easily be avoided by simply adjusting the price at month $t-1$.

  When the direct index formula with a long term relative (10.16) is used, the exercise is even more operationally awkward. The complier would have to adjust the base period price, p_i^0 in order to record any quality change. Consequently a different reference price would have to be registered, in order to avoid having to change the index values that were computed in the interim. For example, 10 adjusted prices occurring in the future would require 10 different base prices, a situation that is best avoided.

- Another but less well known advantage, relating to monthly chaining (as opposed to annual), is that any month can potentially be used as a link period, i.e. a new basket can be introduced at any time during the year. This can be an attractive feature where production difficulties may have led to an unplanned delay in the introduction of the new basket. But introducing a new basket during a period of abnormal price movements and levels, such as during sales should be avoided.

10.81 That said, many statistical offices have no problems with adopting annual chaining.

Linking and Chaining

10.82 It is generally agreed that weights should be reviewed and eventually revised regardless of the conceptual basis of the CPI. This is to ensure that the basket is as representative as possible of the consumption patterns of consumers to mitigate the incidence of substitution bias, which is inherently present in a CPI, especially with a fixed-basket index where the q-values are constant over a certain number of years.

10.83 Chain linking involves constructing a continuous price series by multiplying together price indices that have been constructed under different baskets or weighting regimes. Unlike an unchained index, a chain-linked index spanning more than one period or chain cannot be represented either as the ratio of the price of a basket in the current period to that in the base period or as the weighted average of price relatives. This is because the weights are not constant and even the list of items in the basket is variable. This sub-section will present a brief overview of the chaining and linking exercise.

10.84 Whilst it is necessary to chain a CPI when the weights change, it is possible to chain an index more frequently, every month, say. For the ratio of averages, provided that the weights and item list remain fixed this would yield the same results. However, for the average of relatives the result would usually be that the index would grow more rapidly than it should because of a phenomenon known as "chain drift", which is caused by price "bouncing"[51].

10.85 The general procedure behind chain linking can be illustrated with the following relationship, where a series of bilateral price indices are chained together:

$$P^{t/0} = P^{t/0} \times P^{2/1} \times \ldots \times P^{t-1/t-2} \times P^t \qquad (10.18)$$

10.86 To further expand and to illustrate the simplicity behind the concept of linking by way of an

[51] See CPI Manual, paragraphs 20.60 to 20.61.

example, take an economic time series extends over four years from 2004 to 2007 with the following values:

2004 =	*a* =	10
2005 =	*b* =	15
2006 =	*c* =	25
2007 =	*d* =	30

10.87 Furthermore, suppose that the focus is on a series of period-to-period changes such that the following changes are calculated:

$$P^{05/04} = \frac{b}{a} = \frac{15}{10} = 1.50$$

$$P^{06/05} = \frac{c}{b} = \frac{25}{15} = 1.67$$

$$P^{07/06} = \frac{d}{c} = \frac{30}{25} = 1.20$$

Where these results are defined as link relatives.

10.88 The link relatives show the changes from the previous period. The links can be chained together by multiplication to calculate changes over any interval of time. For example, the change from 2004 to 2007 can be obtained in the following way:

$$P^{07/04} = P^{07/06} \times P^{06/05} \times P^{05/04} = \frac{d}{c} \times \frac{c}{b} \times \frac{b}{a} = 1.20 \times 1.67 \times 1.50 = 3.00$$

10.89 This yields the same result as if the calculation was done using the direct approach:

$$P^{07/04} = \frac{d}{c} = \frac{30}{10} = 3.00$$

10.90 Similarly, if the index compiler is interested in calculating the change from 2005 to 2007 using the chaining procedure, then:

$$P^{07/05} = P^{07/06} \times P^{06/05} = \frac{d}{c} \times \frac{c}{b} = 1.20 \times 1.67 = 2.00$$

and using the direct approach:

$$P^{07/05} = \frac{d}{b} = \frac{30}{15} = 2.00$$

Table 10.4 Splicing and chaining when a new index is introduced with a revised set of weights

Index A	Index B
2000: $P^{00/00} = \sum_i \frac{p^{00}}{p^{00}} w_i = 1.0$	
2001: $P^{01/00} = \sum_i \frac{p^{01}}{p^{00}} w_i = 1.2$	
2002: $P^{02/00} = \sum_i \frac{p^{02}}{p^{00}} w_i = 1.5$	
2003: $P^{03/00} = \sum_i \frac{p^{03}}{p^{00}} w_i = 2.0$	2003: $P^{03/03} = \sum_i \frac{p^{03}}{p^{03}} k_i = 1.0$
x_1	2004: $P^{04/03} = \sum_i \frac{p^{04}}{p^{03}} k_i = 1.2$
x_2	2005: $P^{05/03} = \sum_i \frac{p^{05}}{p^{03}} k_i = 1.6$
x_3	2006: $P^{06/03} = \sum_i \frac{p^{06}}{p^{03}} k_i = 1.8$

10.91 In general, given a set of link index numbers, which cover for example the period 1997 – 2007, a series of index numbers with 1997 as the base using the chain procedure becomes:

$$P^{98/97} = P^{98/97}$$

$$P^{99/97} = P^{98/97} \times P^{99/98}$$

$$P^{00/97} = \left[P^{98/97} \times P^{99/98} \right] \times P^{00/99} = P^{99/97} \times P^{00/99}$$

$$P^{01/97} = \left[P^{98/97} \times P^{99/98} \times P^{00/99} \right] \times P^{01/00} = P^{00/97} \times P^{01/00}$$

$$P^{02/97} = P^{01/97} \times P^{02/01}$$

$$\text{M} = \text{M} \times \text{M}$$

$$P^{07/97} = P^{06/97} \times P^{07/06}$$

10.92 More generally:

$$P^{t/0} = P^{t-1/0} \times P^{t/t-1}$$

10.93 This leads to the next sub-section, the practice of splicing.

Splicing and chain linking

When the weights of the index become out of date then another index series must be created. The new index will have a revised set of weights (associated with the updated basket) that will reflect the latest available spending patterns of the population. Consequently, two distinct index series will exist. A CPI will, however, require that the old series be combined with the new one so as to create one continuous series. To accomplish this objective, the *splicing* technique can be applied. Take, for example, two index series, A and B, calculated according to equation 10.11 and for which the weights have been updated from w_i in 2003 to k_i. See Table 10.4.

10.94 To make series B continuous with series A, the CPI compiler needs to find the values for the unknowns: x_1, x_2, and x_3. For x_1 the calculation is as follows:

$$\frac{2.0}{x_1} = \frac{1.0}{1.2} \quad x_1 = \frac{2.0 \times 1.2}{1.0} = 2.4 \times 100 = 240$$

10.95 Thus to make the most recent index continuous with the old one, the indices are *spliced* at the year (or period) that is common to both series. The new continuous series with year 2000 as the time base is shown in Table 10.5.

Chaining and splicing to change the weights

10.96 The chaining and splicing technique previously discussed are two techniques that can be used jointly for changing the weights of the index. It can be recalled from the previous discussion on splicing, that:

$$\frac{P^{03/00}}{x_1} = \frac{100}{P^{04/03}}$$

10.97 From which the following can be derived:

$$x_1 = P_{Ch}^{04/00} = P^{03/00} \times P^{04/03} \times \frac{1}{100} = 200 \times 120 \times \frac{1}{100} = 240$$

10.98 According to this calculation, x_1 is the "chained" price index for 2004, i.e., $P_{Ch}^{04/00}$.

10.99 The expression $\sum_i \frac{p_i^{04}}{p_i^{03}} k_i$ is defined as the link relative showing the change in the cost of the fixed basket from 2003 to 2004. Consequently, the price index for 2004 is found by multiplying (chaining) the 2003 price index, which is based on the w basket of series A, by the link relative. For the subsequent periods this is as follows:

$$\frac{x_1}{x_2} = \frac{p^{04/03}}{p^{05/03}} \Rightarrow x_2 = P_{ch}^{04} \left(\frac{p^{05/03}}{p^{04/03}} \right) = P_{ch}^{05/04}$$

$$x_2 = 240 \times 133.3 \times \frac{1}{100} = 320$$

$$x_2 = 240 \times (133.3) \times \frac{1}{100} = 320$$

And so forth.

10.100 The above presentation shows that two overlapping indices can be spliced using proportions, which leads to the technique of chaining. By splicing and chaining the weights can be changed as frequently as desired and is only limited by resource and data constraints they may limit for instance the

Table 10.5 Continuous series with time base 2000

2000	2001	2002	2003	2004	2005	2006
100	120	150	200	240	320	360

availability of weighting information. In the final analysis, the CPI becomes a series of linked indices which are chained together thus ensuring its continuity.

10.101 As time passes it is sometimes appropriate to update the base year to a more recent one. We then have 2 series with 2 different base years. To recreate one series or compare price movements we need to link the 2.

10.102 For example:

	Old Series Jan 1990=100	New Series Jan 1997=100
2006	270	
2007	300	100
2008		104

10.103 The key figures are the index numbers for the 2 series for 2007, **300** in the old series is **100** in the new.

10.104 To change old to new we need to change the base of the old series to 2007, and to multiply each of the old numbers by $\frac{100}{300} or \frac{1}{3}$.

10.105 To find the value for 2006, we have in the new series:

$$270 \times \frac{100}{300} = 270 \times \frac{1}{3} = 90$$

10.106 We may wish to do this the other way round and rebase the new series to the old base.

10.107 100 in the new series is 300 in the old, so we multiply each number in the new series by $\frac{300}{100} = 3$

CHAPTER 11

Special Indices

Introduction

11.1 Chapter 13 of the CPI Manual, paragraphs 13.24 to 13.31, discusses the compilation of alternative measure of inflation, including core inflation, and Chapter 22 of the Manual discusses, amongst other things, the issue of seasonal adjustment. The ILO Resolution says very little on the subject of special indices apart from advising in paragraph 74 that "indices should be presented in both seasonally adjusted and unadjusted terms, if seasonally adjusted data are available".

Background

11.2 The priorities for an NSI are to publish:

- Long, coherent indices with fixed index reference period.
- 12-months rate of changes (or 12-months indices).
- Month-on-month rate of changes (or month-on-month indices).
- Annual average indices/rate of changes

11.3 But for specialist and analytical purposes it may be desirable to construct and publish measures of "core" or "underlying" inflation which show the underlying trend in inflation by excluding those movements which arise from transient factors such as seasonality or other short-term price volatility. Several methods can be used to construct such measures of "underlying" inflation, some more scientific and less discretionary than others.

11.4 This chapter discusses, among the various types of special index, seasonally adjusted indices and indices which measure core inflation. In this connection it is helpful to distinguish between three distinct processes.

- Dealing with seasonal products. This is a technical problem of how to include products in a CPI that disappear temporarily from the market for a period each year, or are always available but at highly fluctuating prices according to season, such as certain fruits and vegetables. This topic is dealt with in Chapter 9.
- The process of seasonal adjustment. This is the adjustment of a CPI to remove seasonal effects caused by regular events or influences such as annual shop sales.
- Smoothing the CPI. The purpose of this is to eliminate or reduce the effects of price shocks or irregular events which affect the CPI.

11.5 The second and third processes, which may be used separately or together to produce "core" or "underlying" inflation indices, are the main focus of this chapter.

11.6 However, as well as covering seasonally-adjusted and core inflation series, the chapter also covers other special indices, such as indices excluding particular products, indices for particular economic sectors, indices excluding or holding constant any indirect taxes, and regional indices.

11.7 These special indices are all related to the extent that they are designed to serve particular user needs concerning the measurement of consumer price inflation. They can be referred to in general as "analytical indices". They decompose or adjust the main CPI in order to shed light on aspects of inflation which may not otherwise be apparent.

Seasonally-adjusted consumer price indices

11.8 In general, if a time series exhibits seasonality, as most CPIs do, it is a candidate for seasonal adjustment. Seasonal adjustment will remove recurring seasonal influences from time series data. The removal of seasonal and other regular fluctuations from a time series by the application of seasonal adjustment methods can help to provide a clearer picture of the underlying movement in the data. The presentation of trend estimates can further help as the latter can add clarity to the basic picture by the elimination of irregular variations which would otherwise obscure understanding and interpretation. However, few countries publish a seasonally adjusted version of their CPI. This raises the question of whether such an

index should be produced and if not, why not? This chapter examines this question but does not attempt to describe any detailed technical methods of seasonal adjustment.

11.9 It is important at this point to appreciate the difference between the CPI and the inflation rate. The CPI is an index number, which shows the level of average prices in a particular month relative to the base period which is set to 100. Comparisons of two index numbers give a measure of inflation over the period in between the dates of the two index numbers. Thus, a CPI of 145.6 in May 2007 and a figure of 152.7 in May 2008 gives an annual rate of inflation of 4.9% (= (152.7 /145.6 – 1) x 100).

11.10 CPIs exhibit seasonal patterns caused by, for example, the seasonal availability of fresh food such as certain fruits and vegetables and other strongly seasonal products. They may also exhibit seasonal patterns unrelated to such direct influences. Seasonal variation in demand can also cause seasonal patterns. An example would be ice cream sales in summer or warmer clothing during colder months where demand is related to holidays and to the weather. Another factor is the pattern of recurring seasonal sales by retailers in many countries. Certain price changes may occur at particular times each year, as a result of an annual price review for, say, transport fares, electricity tariffs or university fees. They may also be due to tax changes which may take effect at a particular time of the year.

11.11 Any of the above events may cause noticeable peaks and troughs when measuring the CPI on a monthly basis. The rate of inflation measured on a month-to-month basis (m/(m-1)) may be misinterpreted if the reason for a particular rise or fall is not explained, as the volatility of the unadjusted index may be obscuring the underlying trend. On the other hand, the annual rate of inflation, measured either by the change in the CPI this month compared with the same month last year (m/(m-12)) or by the average index for the latest 12 months compared with the average index for the previous 12 months (y/(y-1)) will normally not be affected by seasonal changes. It is for this reason that for a CPI the question of seasonality is usually dealt with by focusing on the 12-months rate of changes.

11.12 In some instances, however, the m/(m-12) index may still include some seasonal effects if the timing of the source of the seasonal fluctuation or the size of the fluctuation happens to vary from year to year. For instance, this will be the case if the month when planned tax changes take effect is in March one year and in April the next year. This can be problematic not just for the presentation of 12-month rates of change but also for seasonal adjusted series.

11.13 The effect of applying a seasonal adjustment to the unadjusted CPI will be to spread out the effects of such peaks and troughs over the year. The resulting CPI will not therefore be an accurate record of the actual price changes taking place each month, but will rather show their underlying trend. As discussed below, this is useful for some purposes, but it should never be the only version of the CPI that is published. The unadjusted "headline" CPI should be published alongside the seasonally-adjusted CPI. If the aim of the CPI is to compare the prices that consumers actually face in two consecutive months, regardless of any seasonal effects, then the publication of a month-to-month unadjusted inflation rate is beyond question. If there is an apparently erratic movement, the statistical office should attempt to explain the reason (for example, "The index for clothing fell last month because of significant reductions in price as a result of the end-of-season discounts").

11.14 The two series meet different needs. The seasonally-adjusted CPI will be useful for those interested in the underlying or trend rate of inflation, while the unadjusted CPI, being a measure of the actual price changes experienced by the consumer, is more appropriate for, say, the deflation of monthly sales data or other economic series such as many components of GDP or, perhaps, for indexation of state benefits and wages.

Seasonal adjustment methods

Seasonal adjustment programmes

11.15 The seasonal adjustment of a CPI can be done either by adjusting the all-items index (or the individual group indices) or by adjusting the mean prices (or mean price ratios) for those products where there are strong seasonal patterns and the availability of some products at certain times of the year is very limited. The second of these approaches, which has lead to concerns over interpretation due to its mixture of actual market prices and adjusted prices, is discussed in Chapter 9. The first is much the easier approach because of the ready availability of standard packages and is normally to be preferred but can only be undertaken if prices can be collected throughout the year. A standard seasonal adjustment program, such as X-12-ARIMA (developed by the United States Bureau of the Census), can be applied. However, the use of such packages requires some judgment from the

statistician. For example, are the seasonal factors additive or multiplicative? For how long a period should the moving average be calculated? Different assumptions can give different results. It also requires the identification and measurement of non-systematic movements due to chance or to irregular events. It is desirable to eliminate the latter in order to identify the general direction of the time-series, that is, the longer-term trend, and - just as importantly - any changes in the trend. In the case of a CPI, the irregular component can be relatively large due to the influence of, for example, changes in excise duty and the dates on which they are applied and also, where applicable, in mortgage interest payments due to changes in interest rates. This can obscure the seasonal pattern. For this reason it is technically most appropriate to seasonally adjust the CPI after it has already had much of the irregular component taken out.

11.16 A final point on seasonal adjustment which statistical offices need to recognise is that in a standard X-12 type of package the final seasonal adjustment factors are not usually available until there is a time series of at least 24 months and the factors will be regularly re-computed. The process of seasonal adjustment will therefore change the original seasonally-adjusted series for most if not all of that period. Since the CPI is normally a non-revisable index, it would be difficult to use a seasonally adjusted CPI for certain applications such as indexation of pensions or contracts.

11.17 To return now to the initial question, should countries produce a seasonally adjusted version of their CPI? A seasonally adjusted CPI can be a useful macroeconomic policy tool for those analysts and policymakers interested in understanding more about the inflationary process. Many statistical software packages today will include a seasonal adjustment routine as a standard feature. Hence, some of the reasons that were often raised in the past for not adjusting the CPI for seasonal effects, such as a shortage of skilled personnel and an absence of computers, are no longer an issue for many countries. Nevertheless, the production of a seasonally-adjusted CPI will not normally be a priority for an NSI and in many cases is left to the users to do.

11.18 Perhaps the biggest issues relating to the usefulness of a seasonally-adjusted CPI are (a) the variance of the seasonal adjusted series and (b) its vulnerability to revision. These issues can arise as a result of two factors:

- "Noise" in the series.
- Uncertainty in the calculation of the seasonal adjustment factors.

11.19 Noise in the series can be assessed from the irregular component that is automatically estimated as a by-product of the calculation of seasonal factors. Uncertainty in the latter can be investigated by carrying out an analysis of revisions to the seasonal factors when they are re-calculated as additional data become available. But the usefulness of such analysis is limited by the difficulty in distinguishing between revisions occurring as a result of real changes in seasonal patterns and those resulting from uncertainty in the original calculation.

11.20 Clearly it is possible to reduce the variance associated with the calculation of seasonal factors by removing specific identifiable effects from the original series. For instance, this can be done by seasonally adjusting the CPI, after taking out the effect of changes in measurable irregular components such as excise duty and mortgage interest payments. The potential difficulties in the calculation of seasonal factors which would have arisen as a result of such changes in indirect taxes and mortgage interest payments are then greatly reduced.

11.21 Perhaps the more important point to note is that the seasonal adjustment procedure is not entirely reproducible in the sense that different operators would not necessarily come up with the same series. This is because it is impossible to have "final" estimates for the seasonally adjusted series until 18-24 months down the road and because the seasonal adjustment procedure asks the operator of the adjustment process to choose various options as indicated above. It is for this reason that some statistical offices which produce a seasonally-adjusted series label it as an "analytical series".

Moving averages

11.22 Seasonal adjustment is not, of course, the only way of smoothing a time series. For example, the price changes resulting from a monthly CPI can be presented as a 3-month moving average, or a 12-month moving average. Such presentations are discussed in more detail in Chapter 14. Of course, most seasonal adjustment procedures are based on the use of moving averages to form estimates of the underlying trend and then seasonal adjustment factors are calculated relative to the estimated trend.

Core inflation and smoothed indices

11.23 Many analysts of inflation are interested not only in the basic CPI, but also in a measure of what is

called "core inflation", "underlying inflation" or other such terms. Although many countries publish "core inflation" indices, there seems to be no clear definition of the term. The basic idea, however, is that there are often exceptional movements of particular prices represented in a CPI which may give a distorted picture of the general rate of inflation, in the sense that the movement in the all-items index is quite different from the movement of most prices comprising the index. The aim is to be able to perceive what the inflation trend would be if the effects of transient or temporary influences are removed from the index.

11.24 To give a simple example, if there was a rise in the rate of value-added tax in a certain month, the index level, all else being equal, would show a rise for that month. Consequently, the CPI annual (m/(m-12)) change would also show an increase for that month and also for the 11 subsequent months until the tax-rise month dropped out of the calculation. If such a one-off effect was not accounted for in some way, the resulting inflation figures would not provide a faithful representation of the underlying rate of inflation. But as with seasonally-adjusted CPIs, a core inflation index should not be a substitute for the unadjusted CPI, rather it provides an analytical tool to better understand inflation.

11.25 The challenge is to find a measure of inflation that is free from, or at least less liable to, such distortions. Several methods are used for measuring core inflation.

The exclusion approach

11.26 The first approach may be described as adjustment by exclusion. This involves changing the product coverage of the CPI by removing those products for which prices are notoriously volatile (e.g. fresh food, and many energy products). By excluding these series from the overall CPI, the modified index should be less variable than the original index.

11.27 Comparison of the original series with the adjusted core series will show greater or lower inflation rates depending on (a) the weight of the components removed and (b) the price movements of the components removed relative to the price movements from the remaining components in the index.

11.28 However, the exclusion method suffers from certain disadvantages. The past volatility of a particular series may not be a reliable guide to the future volatility of the series. For example, the volatility of fresh food prices, which is due at least partly to random weather events or simply seasonal availability, may at some future point in time be reduced as a result of technology changes in food production. An example might be the growing use of poly-tunnels, which can result in a major extension of the growing season. Likewise, new instances of volatility may begin to occur and may become long-lasting. For instance, oil prices have not always been volatile. The problem therefore is how to select those products which should be excluded from the CPI for the purposes of constructing a core inflation index, and how to monitor their prices with a view to possible removal at a future point from the core index. It is for this reason that some statistical offices prefer not to define a "core inflation" index as such, but instead publish several alternative indices which exclude different product groups such as CPIs which exclude: energy; energy, food, alcohol and tobacco; energy and unprocessed food; energy and seasonal food. These should not be labelled as "core inflation" indices, but they are useful for users who may wish to treat them as such. This approach allows national statistical offices to publish whichever aggregations approximate to the likely user definitions of "core inflation".

11.29 Another disadvantage of excluding volatile products is that the excluded products may not only be volatile but also exhibit a longer term trend of their own, which may be different from that of the remainder of the products in the CPI. This could well be the case for oil prices, for example, where, despite the frequent rises and falls, there has been an upward trend for many years. Excluding oil permanently from the core index could, in this particular case, underestimate the long-term inflationary trend. Lastly, using the exclusion method means that the core CPI is measured with a reduced sample compared to the overall CPI. This could reduce the statistical reliability of the estimate if the excluded items account for a large share of the basket. Such could be the case, for instance, in some developing countries where unprocessed food accounts for sometimes more than 50% of total household expenditure.

The smoothing approach

11.30 A second method used for estimating core inflation employs a variety of smoothing techniques. Typically this involves some form of averaging, either at the level of the individual price series or at the aggregate level, in order to show the true trend more clearly. This method cannot entirely filter out irregular and un-measurable price shocks or seasonal effects, such as those due to varying weather but can be undertaken in conjunction with a CPI where the effects of changes in measurable irregular components, such as excise duty and mortgage interest payments, have been taken out.

An annual rolling year index is an objective and reproducible index number method of simultaneously providing a seasonally adjusted and smoothed index, which will generally provide a reasonably accurate picture of the trend in inflation (see chapter 9).

The adoption of specific adjustments to eliminate particular developments

11.31 A third method of arriving at a measure of core inflation is by means of specific adjustments to the recorded prices at certain times so as to eliminate the effect of particular developments on the measured aggregate rate. In general, this method does not provide a systematic, transparent or verifiable inflation indicator and for these reasons is not generally recommended. However, adjusting for changes in indirect taxes is a special form of specific adjustment which is quite commonly used, though it nevertheless results in certain problems. It raises a number of questions: which types of tax should be taken into consideration, and should taxes on only final consumer products be excluded, or taxes at earlier stages of production as well? The general issue of tax-exclusive or constant-tax CPIs is dealt with later in this chapter.

Trimmed means

11.32 There are a number of methods all based on the idea of "trimming". Essentially, a trimmed index is one which has had extreme values removed, thereby giving more weight to the central values, which may be regarded as typical and hence suitable as a measure of underlying inflation.

11.33 There are a number of operational methods of applying trimmed means. One of the most frequently used methods first takes each product group (it could be an elementary aggregate or a higher aggregation) and ranks the weighted price changes each month. The trimmed mean is calculated by removing, say, the 15% highest and lowest changes in the weighted distribution, and then taking the average. An extreme version of this method is to take simply the median observation as the core inflation figure. The method of using trimmed means is somewhat arbitrary – as well as, of course, the choice of the 15% "tolerance" threshold. The results will certainly reduce instability in the index, though the impact will generally be to reduce the measured rate of inflation because exceptionally large price increases tend to be more frequent than exceptionally large falls except during "sale" periods when products are sold at heavily discounted prices. This form of "bias" can be eliminated by taking some percentile of the price distribution centred below 50%. Concern has also been expressed that in trimming the left tail of the changes in prices, such measures might disregard important persistent downward price trends in particular sectors such as computers and other hi-tech goods. It can also be noted that in general, shocks are excluded, while gradual returns to normal prices are included, so what comes out of this approach in the end and the interpretation of it is not very transparent.

Other special indices

11.34 In addition to the special types of CPI discussed above, countries compile many other special CPIs unrelated to core inflation or seasonality. Such indices are published for special uses. They include the following examples:

- Indices relating to particular socio-economic groups, which are normally computed by re-weighting the prices collected through the normal CPI price collection exercise to reflect the different expenditure patterns, but not the different brands and shops visited, by the groups in question. These indices have been criticised for their lack of specificity. Indices under this heading include:
  - By household size/composition.
  - Pensioners.
  - Low income groups.
- Regional indices. These include:
  - Capital cities.
  - Urban centres.
  - Rural areas.
- Indices excluding certain product groups. These include:
  - Without alcohol, tobacco etc ("health" indices).
  - Without mortgage interest.
  - Without indirect taxes.
  - Without government regulated (administered) prices.
- Special sector indices. These include:
  - Catering sector.
  - Owner-occupied housing.
- Special product-group indices. These include.
  - Energy.
  - Durables.

- Services.

- Indices that eliminate the impact of changes in indirect taxation. These include :
  - Constant-tax indices.
  - Indices which exclude indirect tax.
  - Indices which exclude the direct impact of interest rates, for example on mortgage interest payments.

11.35 Indices such as those listed above may be provided by the statistical office under private arrangements with users (including government departments) or they may form part of the data published regularly alongside the main CPI. It is a matter for each country to decide which special indices to include with the release of the main CPI. Usually resource availability and user needs will dictate which indices are published. All such indices should be treated as supplementary to the main CPI. It should also be noted that the publication of several CPI variants could be confusing to the public and potentially undermine credibility in the headline CPI unless provided with sufficient explanation to facilitate comparative analysis. The integrity of the CPI can also be undermined by not publishing special indices provided as a special service to other users, although consideration of issues relating to reliability also comes into play. Chapter 14 deals with presentational issues.

Illustrative examples

11.36 The methods of calculating such indices as those above vary according to the category. Illustrative examples relating to the compilation of some of these indices are given below. The indices excluding certain product groups may be considered first, as they are not only usually the easiest to compile, but they are related – may even correspond exactly to – the first type of core inflation indices discussed in the previous section.

Indices involving product exclusion

11.37 The method is effectively to give zero weights to the product group being excluded. Thus, in the simplest case, the groups relating to alcohol and tobacco (COICOP 02.1 and 02.2) may be retained in the computation but their weights are reduced to zero. The remaining weights will of course fail to add to 100 and must be re-scaled so that they bear the same ratios to one another as before the exclusion of alcohol and tobacco.

11.38 A fictitious example, using just 4 product groups as an illustration of the method, is shown in Table 11.1.

11.39 The figures in Table 11.1 show that the exclusion of tobacco results in a fall of 0.3 percentage points in the index, resulting from the combination of a low weight and a high price increase.

Table 11.1 Example of exclusion of tobacco from a CPI

(A) ORIGINAL CALCULATION INCLUDING TOBACCO

Product Group		CPI Weights	Price Index	Index x Weight
1	Tobacco	5	1.15	5.75
2	Food	30	1.06	31.80
3	Other goods	40	1.88	43.20
4	Services total	25	1.11	27.75
	Total CPI	**100**		**108.5**

(B) CALCULATION EXCLUDING TOBACCO

Product Group		New Weights	Re-scaled weights	Price Index	Index x Re-scaled weight
1	Tobacco	0	0	1.15	0.00
2	Food	30	31.58	1.06	33.47
3	Other goods	40	42.11	1.08	45.47
4	Services total	25	26.32	1.11	29.21
	Total CPI	**95**	**100**		**108.2**

Table 11.2 Constant tax CPI

(A) FLAT-RATE TAX

Month	Basic Price	Flat-rate tax	Observed price	Price at constant-tax	Index of observed prices	Index of constant-tax prices
Dec	3.00	0.60	3.60	3.60	100.0	100.0
Jan	3.15	0.60	3.75	3.75	104.2	104.2
Feb	3.30	0.70	4.00	3.90	111.1	108.3
Mar	3.45	0.70	4.15	4.05	115.3	112.5
Apr	3.60	0.70	4.30	4.20	119.4	116.7

(B) AD VALOREM TAX

Month	Basic Price	Tax rate (%)	Observed price	Price at constant-tax	Index of observed prices	Index of constant-tax prices
Dec	3.00	15.0	3.45	3.45	100.0	100.0
Jan	3.15	15.0	3.62	3.62	105.0	105.0
Feb	3.30	17.0	3.86	3.80	111.9	110.0
Mar	3.45	17.0	4.04	3.97	117.0	115.0
Apr	3.60	17.0	4.21	4.14	122.1	120.0

11.40 A CPI for a particular sector, such as catering, is calculated in a similar way. Here, the first task is to decide which products or product groups comprise "catering". This would probably be COICOP group 11.1. Having decided on this, the calculation is similar to that for the tobacco example in Table 11.1. All non-catering products are effectively given a zero weight. The product groups within "catering" have their weights re-scaled to sum to 100 and the catering index is calculated in the usual way.

Constant tax rate CPI

11.41 A constant tax rate CPI excludes price changes which are directly due to changes in indirect taxation such as sales taxes, value-added taxes, and excise duties on alcohol and tobacco. It is not generally practicable to predict what prices or demand would be in the absence of taxes, so no assumptions are usually made concerning what the weights would be. The index is often referred to as a Consumer Price Index – Constant Tax Rate, CPI-CT. It can be expressed algebraically as follows.

11.42 Starting with a Laspeyres-type index and focussing on index levels which reflect the price movement from a reference period t_0 (which may be, for instance, the previous year's December) to an observation month t_n within the current year so that chain-linking factors can be ignored, then

$$P_{t_0,t_n} = \sum_{i=1}^{g} \frac{p_{i,t_n}\left(\tau_{i,t_n}\right)}{p_{i,t_0}\left(\tau_{i,t_0}\right)} \cdot w_i \quad (11.1)$$

which gives a Laspeyres-type price index reflecting the average change of g item prices $p_{i,t}$ from the price reference period t_0 (which is the previous year's December) to month t_n. The expenditure shares which are used for weighting price relatives are denoted as w_i. All product-related taxes, which may be merged in vectors, $\tau_{i,t}$, are part of the prices observed (and refer to the same periods as the prices).

11.43 The idea behind a CPI-CT is to keep product-related tax rates constant over time. The notation

$${}_L CTP_{t_0,t_n} = \sum_{i=1}^{g} \frac{p_{i,t_n}\left(\tau_{i,t_0}\right)}{p_{i,t_0}\left(\tau_{i,t_0}\right)} \cdot w_i \quad (11.2)$$

indicates that prices in t_0 and t_n refer to the tax rates from the same period t_0. Whereas the prices $p_{i,t_0}\left(\tau_{i,t_0}\right)$ are observable in the base period t_0, the prices $p_{i,t}\left(\tau_{i,t_0}\right)$ are not directly observable. They have to be calculated using the reporting period's

purchaser prices p_{i,t_n}, the product related tax rates τ_{i,t_n} as well as the tax rates of the base period τ_{i,t_0}.

11.44 Indices which are compiled along these lines do not exclude indirect taxes as such but merely assume no changes in taxes compared with those in effect at the base month or period and derive their value from comparisons with the ordinary CPI. Differences in the resulting inflation figures show the contribution of tax changes to the overall CPI inflation figures. Such an index is not a type of core inflation index as the tax-exclusive CPI described below. It is nevertheless of considerable analytical interest, and is relatively easy to construct.

11.45 It works backwards from observed average prices, stripping out any tax changes and replacing them with the base period taxes. If all the taxes were charged as a percentage of the pre-tax price (for example, value added tax), rather than as fixed amounts (flat-rate tax), the CPI-CT and the main CPI would be the same, as long as the rate of tax remained constant. But flat-rate taxes will normally cause differences in the two types of CPI even when the tax is unchanged and may be considered perverse. Table 11.2 illustrates this point.

11.46 In summary the main use of a CPI-CT is for comparing percentage month-on-month index growth rates of the CPI and the CPI-CT. The difference between these two growth rates will be the implicit contribution of tax changes to the overall CPI inflation. The same applies for the comparison of annual growth rates for the CPI and CPI-CT but in this case (as in any other long-term comparison over several years), the term 'constant tax rate index' has a slightly different meaning, because for the CPI chain index the tax rates are to be updated for each new link month December (see below for details). Thus the analytical strength is only fully realised when comparisons are made within a chain.

11.47 It is also clear from equations (11.1) and (11.2), that the analytical interest of the CPI-CT only materialises if it is compared with the CPI. For example, where tax rate changes happen in the observation period, the effect of these changes on prices will be seen by comparing the CPI-CT with the CPI. For example, if the CPI is 121.3 in a given observation period and CPI-CT is 118.1, then the 3.2 index points difference indicates the effect of tax increases since the reference period. From here it follows that the CPI-CT equals the CPI if tax rates do not change between the reference period and the observation period ($\tau_{i,t_0} = \tau_{i,t_n}$).

11.48 It should also be noted that the CPI-CT assumes that the full effect of tax rate changes are reflected in price changes at the moment the tax rate change happens. So the CPI-CT does not reflect the actual real impact of tax rate changes on price levels but merely the direct impact which tax rate changes could have. However, as the CPI-CT will draw on the same weights that are used to calculate the "normal" CPI, the development of these weights does reflect the longer-term impact of tax rate.

11.49 It should be noted that the CPI-CT is not without its analytical difficulties. Suppose that a country applies a value added tax (VAT) on cigarette packs of 20% of the pre-tax purchase price, and that the pre-tax price of a pack of cigarettes equals \$3 in the reference period. The amount of tax per pack equals \$0.6 making the post-tax purchase price \$3.60. The pre-tax price increases by 20% and VAT remains at 20% and in consequence the amount of tax per pack increases to \$0.72. The post-tax price becomes \$4.32. On the other hand, assume that the country had applied a specific flat sum tax on cigarettes of \$0.6 per pack, making the post-tax price of a pack of cigarettes again equal to \$3.60, but then decides to raise the specific tax from \$0.6 to \$0.72 at the same time as the 20% price rise in the pre-tax price. Again the net result will be a post-tax price of \$4.32.

11.50 In the first case, the CPI-CT would show a price rise of 20 percent for a pack of cigarettes (the same as in the normal index, since there was no change in the tax rate), while in the second case the CPI-CT would show a price rise of 16.7 percent for a pack of cigarettes (which follows from applying the base period tax rate). So, while in both examples the effect on the amount of tax paid is the same, the resulting CPI-CTs differ. This is a consequence of applying taxes with different structural characteristics (for example, VAT as opposed to a specific tax) to the same product.

11.51 An index which excludes indirect taxation entirely avoids this feature of the CPI-CT.

CPI excluding indirect taxes (CPI-XT)

11.52 Another particular class of special CPIs are those which exclude indirect taxes entirely. This class of index can be regarded as a practical approach to the issue of dealing with indirect taxes, which removes from the ordinary CPI weights the share of expenditures that is accounted for by indirect taxes, and then pro-rates the remaining weights up to 100 per cent. For example, tobacco, which often carries a high excise tax, has a much reduced weight in a CPI excluding indirect taxes compared with its weight in the ordinary CPI.

11.53 The method of calculating such an index is to compare prices excluding indirect taxes in a given month with prices excluding indirect taxes in the base month.

11.54 The purpose of this type of index is to obtain a better indication of market-driven inflationary pressures at times when other price indices are directly influenced by Government-driven changes. It is designed to measure movements in core prices, excluding price changes which are directly due to changes in the amount of indirect taxation, i.e. the purchaser prices excluding indirect taxes. Analytical uses apart, the CPI-XT may be considered appropriate for escalation of contracts between companies that are exempted from e.g. VAT.

11.55 The following items are illustrative of the sorts of taxes which would be excluded from the calculation of such an index: local authority property taxes and vehicle excise duties, plus all taxes and duties that directly affect retail prices, such as Excise Duties (e.g. on tobacco, alcohol and petrol), VAT, Insurance Premium Tax, Air Passenger Tax and Car Purchase Tax.

11.56 There are some issues in the construction of a CPI-XT, which are not clear-cut as there is no agreed standard methodology. Some items, such as television licences and prescription charges for the dispensing of medicines, are determined by the Government but are normally included in a CPI excluding indirect taxes, because they are elements of a payment for a good or service. Similarly, direct taxes on factors of production (for example, an employment tax, such as a per capita employee tax, which is paid by employers) or on intermediate production stages (for example, when a petroleum revenue tax is imposed on producers) have no direct effect on retail prices and normally are not removed. There is a case for identifying and excluding subsidies since a subsidy is in effect a negative tax, but in practice are often left in the index as it can be very difficult to track individual subsidies and determine their effect on price movements.

11.57 A CPI-XT, like a CPI-CT, does not normally model the actions of retailers in phasing in changes to tax rates and the actions of purchasers in attempting to purchase before indirect tax increases come into effect. At all times, the prices used are the prices left after excluding the relevant level of applicable taxation in the month. If, for example, the duty on a litre of beer is increased by 2 cents per litre, the index assumes that the prices charged from that moment include the 2 cents increase even though some retailers may defer putting up their prices and unchanged prices will be picked up by the price collectors. Similarly, the impact of consumers' purchasing behaviour on expenditure will be reflected only when the weights are updated as part of re-basing and chain-linking, which may be some time after the tax increase. In consequence, a CPI-XT is not completely unaffected by tax changes. It can even be the case that delays in passing on a tax increase mean that the index can fall following a tax rise.

11.58 The starting points for the calculation of a CPI-XT, are the item level indices from the main CPI (normally the elementary indices if the same rate of indirect taxation is applied to all items within an elementary aggregate) and the modified set of weights. The same prices, stratum weights and aggregations up to and including item level indices are used as for the CPI. However, CPI item indices must be converted into CPI-XT item indices before further stages of aggregation.

11.59 All items will fall into one of four categories.

- Subject neither to VAT (or an "ad valorem" purchase tax) nor to other taxes.
- Only subject to VAT or an "ad valorem" purchase tax.
- Only subject to a tax/duty other than VAT or an "ad valorem" purchase tax.
- Subject to both VAT (or an "ad valorem" purchase tax) and to some other tax.

11.60 It should be noted that in practice it can be quite difficult to programme the IT system to be able to produce a net price index as part of the regular and ongoing CPI calculation – for example the price statistician has to decide at what level of aggregation to undertake the necessary calculations.

11.61 The CPI compares prices in a given month with base prices. The CPI-XT compares prices excluding indirect taxes in a given month with prices excluding indirect taxes in the base month. Only average prices for each item can be used to calculate the exclusion/conversion factors as it is impossible to remove tax levels from every individual price quote collected in the field since, in the majority of cases, the relevant information will not have been and cannot be collected. For example, to remove tax from the price of a particular alcoholic drink may require the alcohol content to be known, but this may not always be included in the product specification unless required for quality adjustment reasons. Similarly, in some countries flat rate taxes are applied to, for example, sugar, cacao and chocolate, and for products where these ingredients are used. As it is usually unnecessary and not possible to record the content. In such cases, some average assumptions are used, for example an

Table 11.3 Example of a tax-exclusive elementary aggregate price index

	Index including taxes (flat rate tax of 2.30)			Index excluding taxes		
	Base price	**Current price**	**Price ratio**	**Base price**	**Current Price**	**Price ratio**
Product A	$4.00	$4.50	1.13	$1.70	$2.20	1.29
Product B	$3.00	$2.50	0.83	$0.70	$0.20	0.29
Geometric mean	$3.46	$3.35		$1.09	$0.66	
Item index			**96.8**			**60.8**

estimate of average alcohol content can be calculated for each item, and the relevant tax rate applied.

11.62 For items not subject to taxation, the CPI-XT prices are the same as the normal CPI prices.. For items subject only to VAT or other ad valorem taxes, it is easier to use index numbers than average prices for the calculation. The index less the proportional tax level in the current month is expressed as a percentage of that in the base month to get a new index. However, it will only differ from the CPI index if the VAT rate has changed in between. If VAT is imposed on a previously untaxed item, this should be treated as a change in VAT rate from 0% to the appropriate rate.

11.63 Some taxes and duties are levied on a flat-rate basis (say $1 on a bottle of wine) rather than as a percentage. For items subject to these types of tax, it is necessary to use price levels rather than index numbers to remove their effect. It should be noted that a rise (due to factors other than change in duty) of, say, 25 cents on an item has more effect if tax is excluded so the CPI-XT will differ from the CPI. For example, for an item which retails at $2.50 including 50 cents tax in the base period:

CPI:	CPI-XT:
base price = $2.50	base price = $2.00
current price = $2.75	current price = $2.25

So the CPI = 110.0 but the CPI-XT = 112.5

11.64 It follows that for items with higher levels of taxation, there will tend to be larger differences between the CPI and the CPI-XT. However, this effect does not distort the CPI-XT to the same extent since any item with high tax levels will also have a reduced weight.

11.65 An illustrative example showing the impact resulting from a flat rate tax is shown in Table 11.3.

CPI excluding indirect taxes and mortgage interest payments

11.66 This index is designed to measure core movements in "underlying" prices, excluding price changes which are directly due to changes in indirect taxation and interest rates. The purpose of the index is to get a better indication of inflationary pressures at times when other price indices are influenced either directly or indirectly by Government-driven changes. In addition to the exclusion of mortgage interest payments, taxes and duties that directly affect retail prices are excluded as in the CPI-XT. The methodology is the same as that used for CPI-XT. For items subject to flat-rate taxes, such as alcohol or tobacco duties imposed by some governments, the CPI excluding indirect taxes and mortgage interest payments can differ from the normal CPI at the all-items and item levels even when there are no changes in taxes as is the case with the CPI-CT. This is because price changes represent a greater proportion of the price excluding taxes used in the calculation of the former than the price including taxes used for the CPI.

11.67 It is also found that some of the prices excluding taxes can be very low. These have the effect of pulling down the geometric mean price, and hence the CPI excluding indirect taxes and mortgage interest payments, relative to the normal CPI. Again this is similar to the CPI-CT. This is illustrated in Table 11.4 where the CPI and the CPI excluding indirect taxes and mortgage interest payments are calculated for an item comprising two products, where the average flat-rate tax for the item is $2.30 in both the current and base periods. The table illustrates both the calculation of the net price index and the difference between Jevons and Dutot[52].

[52] In the table the different price level and price changes of the two products could indicate that they are not close substitutes (homogenous), for which reason the Dutot should not be the first choice. A Carli gives an index of around 79.

Table 11.4 Example of a CPI calculation (excluding indirect taxes and mortgage interest payments)

	CPI: Including taxes Geometric mean (flat rate tax of $2.30)			**CPI: Excluding taxes & mortgage interest payments Geometric mean**		
	Base price	*Current price*	*Price relative*	*Base price*	*Current price*	*Price relative*
Product 1	$4.00	$4.50	1.13	$1.70	$2.20	1.29
Product 2	$3.00	$2.50	0.83	$0.70	$0.20	0.29
Geometric mean price	$3.46	$3.35		$1.09	$0.66	
Item index			**96.8**			**60.8**
	CPI: Including taxes Arithmetic means			**CPI: Excluding taxes & mortgage interest payments Arithmetic means**		
Arithmetic mean price	$3.50	$3.50		$1.20	$1.20	
Item index			**100.0**			**100.0**

11.68 The geometric mean formula implicitly assumes that consumers will switch purchases of particular brands to cheaper alternatives when price relatives change. In the example above, this implies a greater degree of substitution towards product 2 when taxes are excluded. The table also shows that the equivalent arithmetic calculation, using the ratio of arithmetic means, leads to both indices being 100. This illustrates another point, that differences between the two indices using geometric means do not necessarily imply similar differences when arithmetic means are used. Similar situations can arise with the CPI-CT.

Regional Indices

11.69 The decision to compile regional indices is generally driven by economic policy needs. Although national CPIs should in general have a national coverage, it may be the case that certain regions are excluded from coverage (either weights or prices, or both) because the value of consumer purchases in the region is so small, relative to the country as a whole, that even significantly different price trends (although in the event unlikely in the longer term) would not affect the national CPI to any significant extent. However, if a country is publishing regional CPIs, it is necessary to ensure that the coverage of the elements of the CPI (weights and prices) in each of the separate regions is sufficient to calculate CPIs of the required accuracy. Each regional CPI is calculated in the same way as a national CPI, using regional expenditure weights and regional price changes. Of course, it may be possible to calculate a CPI using national weights and regional prices (or vice versa) but these may only be regarded as approximations to a genuine regional CPI.

11.70 Aggregating regional CPIs to the national level is simple in principle but may not be in practice. The method will depend on the extent to which the national CPI calculation makes use of the basic regional price data. It is probably best to include a regional dimension in the definition of the elementary aggregates. Thus, an elementary aggregate might be related to a certain product in a certain outlet type in a certain region. In the absence of such a method, the aggregation will need to be at the level of elementary aggregates from each region, weighted together to a national total using the weights for each elementary aggregate in each region.

CHAPTER 12

Data Validation

Introduction

12.1 Chapter 9 of the CPI Manual, paragraphs 9.139 to 9.177, discusses data editing, the identification of possible outliers and errors and the verification and correction of prices data. It advises that if an "outlier" price is found to be correct, then it should be included in the index but if it proves to be an error it needs to be corrected by entering the correct price if this is possible or by imputing a price, unless it is considered unrepresentative by some pre-defined rule. Where it is not possible to verify the price it can be accepted or amended according to pre-defined practice. The Manual also makes the important point that it is not necessary to apply the same degree of scrutiny to all reported prices as some will carry more weight in the index than others. The ILO resolution points to the fact that "CPI estimates are subject to errors that may arise from a variety of sources" and advises compilers that they "need to be aware of the possible sources of error, and to take steps during the design of the index, its compilation and construction processes to minimize their impact, for which adequate resources should be allocated". The Resolution is not prescriptive in terms of the particular actions which should be taken or the processes which should be adopted. In practice, outliers are detected not only through an examination of prices but also of price movements. Thus operational procedures are often geared up to identify outliers in price movements as well as in price levels.

Background

12.2 Data validation and editing procedures that are used to detect and correct errors in the prices and weights and other inputs into index construction are an important issue. Firstly, they can detect data problems that could undermine the statistical integrity of the index. Secondly, the procedures themselves, if applied wrongly, can have a systematic numerical impact on measured inflation which can lead to bias. The adopted procedures also have operational consequences. Good data validation and editing procedures can not only improve the quality of the price index but also result in operational efficiencies in the compilation of the CPI. This chapter provides an overview of the procedures that can be used. The validation checks, which are described in this chapter, focus on the operational and statistical processes for checking the price quotations used in the compilation of the CPI and on the use of analytical methods to check the credibility of the resulting indices.

12.3 The primary goal of editing the CPI prices data is to ensure that the resultant indices are a correct representation of the movement in consumer prices experienced by the reference population. It therefore follows that the purpose of editing should not only be to obtain perfectly accurate raw price information but also to end up with representative final prices and a credible price index. This emphasis on the credibility of the outcome and the potential to influence this should be the overriding guide in determining how much time to spend on checking the input data. It also emphasises the importance of the index compiler's task to examine the output and determine whether or not the results can be considered to be representative of what has actually happened during the period. The power of analysis in checking the credibility of the price index should not be underestimated.

12.4 Data validation and editing processes can also provide an input into the long-term methodological development of the CPI. For example, an analysis of the behaviour of the prices sample over time may show an increase in outliers. This may indicate that an elementary aggregate is becoming increasingly heterogeneous or that the existing sample, perhaps the items in the sample or the outlets at which prices are collected, is becoming less representative and needs to be updated. Using editing techniques for this type of analysis helps to ensure the future credibility of the price samples and the indices. Keeping a record of the results of editing may provide additional evidence about the make-up of the elementary aggregate and sample as well as providing the necessary audit trial.

12.5 Because prices in shops may change too quickly for checks on reported prices to be made, editing needs to be done quickly. In addition the

tight production timetable for a CPI requires the quick detection and correction of errors. Prolonged and indiscriminate examination of prices is extremely time-consuming and not an operational option. "Real time" auditing and editing of prices in the field at the time of collection has an important role to play. The index compiler should aim to maximise the amount of interactive editing of prices at the time of price collection[53] and arrange for as many checks as possible to be made of extreme prices or price movements before the data arrives at headquarters. Editing at headquarters follows editing in the field.

12.6 The following validation checks can be applied to all prices collected locally, regionally and centrally, except for checks using hand-held computers which can only be applied to prices collected locally. More guidance on validation checks conducted in the field when price collection is taking place is given in Chapter 6. Advice on quality management systems within the office is given in Chapter 15. Objectivity and transparency are key considerations.

Data validation and editing procedures in the field

12.7 No matter which form of collection – paper forms or hand-held computers - is used, it is essential to provide procedures for the signing-off of data checking and, where appropriate, the transfer of information to Headquarters.

12.8 Price collectors should check, preferably before they leave the outlet or lose contact with the shopkeeper, that prices have been collected for all items or are recorded as unobtainable and that the prices obtained look credible. Using codes to indicate various situations encountered while pricing will make the recording of the information more efficient. For example, the use of "R" to denote a recovery price – a price returning to its "normal" level, following a reduction in a sale, or an earlier special offer. More details are given in Chapter 6.

12.9 Several checks can be carried out on data collected in the field, especially where these are entered into hand-held computers. The most useful tests are the price change check and the minimum-maximum (or "min-max") check (see below). Where paper forms are being used, a less sophisticated version of what follows may be applied, but the principle remains the same. For instance, the paper form may include the previous month's price and the percentage variation allowed. The price collector can then use a calculator to check whether the new price is an outlier which needs to be checked there and then.

- **Price change check.** The price collected is compared with the price for the same product in the same shop in the previous month. A warning is given if the change exceeds plus or minus a percentage threshold specific to the particular item and determined by the variance in previous prices. For instance, this might be 50% for home killed meat which can be subject to relatively large price fluctuations and only 30% for books where historically the price change from one month to the next is small. It may not be appropriate to apply this test to all items. For example, the price statistician may decide to exclude fresh vegetables and fruit from such a test if their prices have an extremely large monthly variation, as it is unlikely to be cost-effective. If there is no valid price for the previous month, for example because the item was out of stock, the check can be made against the price two months ago or, failing that, three months ago.
- **Min-max check.** This check identifies cases where the price entered exceeds a maximum or is below a minimum pre-set indicative price for the item of which the particular product being priced is representative. The range is derived from the validated maximum and minimum values observed for that item in the previous month (this may or may not be across all regions and shop types), after a scaling factor has been applied. The factor will normally vary between items to reflect previous price history for the item across all outlets.

12.10 Where hand-held computers are being used, these can be programmed so that if either test fails, a warning message appears on the hand-held computer screen and the collector can proceed with data entry only after confirming that the price is correct and entering an explanation for the large price change or unusual price in response to this warning.

12.11 Price collectors can use the type of filtering described above not only to look for possible errors but to ensure that they have obtained extra information for all price movements for which some explanation may be needed.

12.12 As a further precaution, the price data can be put through the same types of check by the collecting agency on their central computer system

[53] For example, using outer-bounds of the price change compared with the previous month, that is, the detection of outliers through the use of pre-specified limits for price changes, the latter being determined by the previous month's price change behaviour.

after all local data have been submitted, to ensure that all unusual prices or price changes have proper explanations that can be referred to later in the processing cycle.

12.13 It should be noted that reports of "no price change" can also be wrong - but such errors can be difficult to detect. One way of detecting them is to maintain a record of the last time a price change was noted. If no price change has been shown for a long time, the shopkeeper can be asked to verify that the price is still valid. The length of time considered to be "long" will vary between products and the rate of inflation. As a general rule, any price that has not changed for a year is suspect.

Data validation at Regional or National Headquarters

12.14 It is just as important that, as in the field, data validation and editing procedures are undertaken at Headquarters and are done fast enough to allow price collectors to check outliers with shopkeepers (within the timescale before prices change) and within the deadline required for index computation. The following represent some of the more common validation checks that can be applied by staff at Headquarters.

Data editing

12.15 Once the price information has been collected and recorded it has to be edited. Data editing is the process of ensuring correct and usable data for calculation of price indices for elementary aggregates. Data editing is sometimes referred to as input editing. As indicated earlier there are two steps in this process.

- The detection of possible errors and outliers.
- The verification and correction of data.

12.16 The detection of errors in the collection and recording of price information must occur as soon as possible after the information is actually collected. Detection is usually achieved by examining price movements and checking those that exceed some pre-defined limits, as described above, or appear to be unrealistic based on an analysis of all available information.

12.17 It should be noted that while price collectors should examine every price they collect, subjecting every collected price to the same level of examination by collection supervisors and index compilers is not considered necessary and generally is not feasible. It is recommended that to improve cost-effectiveness, some form of significance rating should be applied to determine how much time and effort should be expended on editing individual prices.

- In general, all things being equal, prices from elementary aggregates with relatively small price samples should receive more attention from the index compiler. This is because, if the weights of the elementary aggregates are broadly equal. Each individual price movement from these elementary aggregates will have a much more significant influence potentially on the index calculations than any individual price movement from an elementary aggregate with a large number of price quotes.
- Price samples from elementary aggregates with high expenditure weights should also be examined critically as the high expenditure weight will make all price movements within the sample significant to the index calculation.
- The highest risk is associated with elementary aggregates with relatively large weights but few price quotes and with complex index construction. This situation is associated with utilities and other services which account for relatively large expenditures and where there may be only one or a handful of suppliers and prices are based on complex tariffs. Petrol prices could be another example.

12.18 There are two main categories of checking for identifying possible data errors and outliers:

- Non-statistical checking.
- Statistical checking.

12.19 Some of the techniques discussed in this section work best when applied to large quantities of data. The best results will therefore be obtained if conducted at the location where many prices are available to any one analyst. This will generally be regional offices or, more probably, head offices. However, the techniques can be adapted and still be applied to prices held by a small collection centre as a way of quickly and efficiently detecting extreme prices. Abnormal prices such as sale prices, or price movements, such as sale recovery prices, may be excluded from manual and automated procedures for the detection of outliers, in particular the setting of upper and lower bounds, but should nevertheless be checked, for instance by reference to previous price history.

Non-statistical checking

12.20 In this handbook non-statistical checking refers to the manual inspection of the data. The data are usually presented in tables, sorted and filtered. This type of checking can be performed by price

collectors, their supervisors or Headquarters. It includes the price change and min-max tests already referred to as well as all kinds of logical and formal tests of the data (e.g. that the numbers don't include letters, or only zeros, that the price is not a multiple of 10 or 100 of previous price, or not 1/10 or 1/100 of the previous price. Much of this non-statistical checking relies on some form of automated analysis to help identify those prices which should be subject to more detailed manual inspection.

12.21 Comparing recently collected prices with previously collected prices can be expanded to include comparison with prices of similar products collected from similar outlets by different collectors in the same region. Once prices have been delivered to and collated by Head Office the price change and min-max tests can be repeated based on a comparison of the price levels and percentage movements of the new prices collected and the results sorted by the degree to which the observation is an outlier and tabulated. This editing focuses on the price level and change for a particular item being priced in a particular shop against the average price level and change for the "same/similar" item in all shops in that particular month. It differs from interactive editing in the field which is done by reference to the price history of that particular item in that particular shop rather than by reference to "similar" price quotes in the price collection month. The data can be grouped, for example by elementary aggregate, to make the editing task faster and also to enable the distribution of the price movements to be observable.

12.22 All price movements falling outside the pre-assigned range should be examined. The limits can be set at different values to suit the price volatility of different elementary aggregates. For instance, as with editing in the field, the limits for fresh produce can be set with wider margins than those for manufactured products such as clothing and furniture. These limits can be changed over time as experience and circumstances demand.

12.23 When using filters, the price statistician should monitor the proportion of records that are incorrectly listed as probable errors. If this proportion is consistently too large then the cut-off limits should be adjusted to limit the number of records, selected for checking, to those with movements most likely to be errors or outliers.

12.24 Selection of price movements by the filter procedure does not mean that the price movements should automatically be omitted from the CPI calculations. Automatic deletion of records when the acceptable limits are exceeded is strongly discouraged (see the CPI Manual paragraph 9.153). Prices which have been identified as outliers must be checked for credibility and that they are representative. For instance, some types of products do not experience regular small price changes. Due to economic circumstances, manufacturers might save up a series of small increases and introduce one big change just occasionally. Movements due to situations such as this should be recognised from experience, industry monitoring and from information passed on from the price collectors.

Statistical checking

12.25 Statistical checks perform the same basic filtering purpose as the non-statistical filtering techniques just discussed. The main conceptual difference is that the techniques automatically calculate the limits for acceptable movement based on the data. These techniques have the benefit of automatically adjusting the acceptable limits as new price data are received and in line with any overall change in price volatility. These techniques require a large amount of data in order to provide reliable results and so are best suited to index compilers in regional and head offices where prices data from several collection centres will have been collated and stored rather than at the local level.

12.26 Statistical checking compares each price change with changes in the other items from a given price sample. The chosen price sample is usually the sample to which the item being checked belongs, but the sample for testing may be a combination of price samples for similar products. It can also be updated as more prices are received from the field. For each of the methods described below the price ratios may measure the price change over any time period: for instance, the change from the previous period or the change from the same period in the previous year.

The use of median and quartile values

12.27 One method of setting the limits to determine whether a movement is a possible error is based on the median and quartile values of the price ratios from the sample. The acceptable limits are set as a predefined multiple of the range between the median and the quartiles. Any observation with a price change outside this range is identified as a possible error. The major benefit of a method like this is that it is not affected by any single outlier value. A worked example is provided in Appendix 12.1. The CPI Manual discusses this method in paragraphs 9.155 to 9.158.

12.28 The basic approach to estimating sensible upper and lower limits of acceptable price movement relies on the assumption that the

observed price changes are normally distributed. Under this assumption, the distance between each of the first and third quartiles (R_{Q1} and R_{Q3}) and the median (R_M) will be the same: call this distance 'D_M'. Operating under this assumption, the proportion of price changes that are likely to lie outside specified upper (L_U) and lower (L_L) limits can be estimated from a normal distribution table. The limits can be defined as:

$L_U = R_M + C \times D_M$; and
$L_L = R_M - C \times D_M$
where C is a user defined value.

It will be seen later that a variation of this basic approach is recommended to allow for the skewed distribution of price changes which can be observed in practice.

12.29 If C is defined as equal to one, then approximately 50 per cent of the observations will lie between the upper and lower limits. Using the standardized normal distribution, this is equivalent to setting the limits at plus or minus 0.7 times the standard deviation (σ) from the median. The following table provides approximate multiples of σ for selected values of C and the associated percentage of the observations that will be flagged as possible errors and outliers.

Table 12.1 Selected values of C and the proportion of observations flagged

C	σ multiplier	Expected proportion of observations flagged
1	0.68	50%
2	1.37	17%
3	2.07	4%
4	2.75	0.7%
6	4	0.14%

12.30 In practice, there are serious shortcomings with this method as described.

12.31 In normal circumstances, the majority of observations for many products will not show any price movement. Therefore the values of the quartiles are likely to be very close to the median value. As a result of this, using small values for C is likely to cause the majority of price movements to be flagged as possible errors and outliers. To demonstrate this effect, 16 additional observations indicating no price movements have been added to the sample of 30 observations used in the first worked example. These are shown in example 2 in Appendix 12.1. A price sample with at least one-third of the observations showing no movements would not be unusual for many categories of items. If C is set to 2, then 60 per cent of the actual price movements would be flagged as possible errors, compared with 30 per cent in the unadjusted sample.

12.32 The index compiler should experiment with different values of C for different product groups or outlet types to determine appropriate values for local use. The CPI Manual recommends that a relatively low value of C should be used. C need not be an integer.

12.33 The distribution of prices and price movements is rarely normal, rather in most cases a skewed distribution exists. Thus the underlying assumption of a normal distribution is invalid and the use of symmetrical upper and lower limits will result in a skewed distribution of prices flagged up as possible errors or outliers. This is operationally inefficient and the examination of differing proportions of "low" and of "high" prices and price movements could lead to bias.

A modified use of median and quartile values

12.34 To use the above method in practice, the CPI Manual recommends that three modifications are made

- Based on the simple price ratios, the distances from the median represented by price decreases are not as large as the distances represented by price increases. As an example, consider a case where a product is on special offer at half price. This is represented by a price decrease of 50 per cent. However, to return to the original price requires a 100 per cent increase. To make the calculation of the distance from the centre the same for extreme changes for price decreases as for the price increases, the price ratios should be transformed. The transformed distance, S_i, for the i^{th} price observation can be calculated as:

$$S_i = 1 - \frac{R_M}{R_i}$$

if $0 < R_i < R_M$

$$S_i = \frac{R_i}{R_M} - 1$$

if $R_i \geq R_M$

The observations with a price ratio lower than RM have now been transformed into the negative of the increase required to return the price ratio to the value of *RM*. Any observations with a price ratio equal to RM will have a

transformed price movement of zero. Observations with a price ratio greater than *RM* have been transformed to show changes as though they had increased from *RM*. The procedure is then carried out on the set of S_i.

- In situations where the quartiles (*RQ1* and *RQ3*) are quite close in value to the median (*RM*), many small price movements are likely to be identified as possible errors or outliers. To reduce this problem, items with no price movements may be removed from the calculations. If the acceptance interval is still very narrow some minimum distance should be set. A suggested starting value is 5 per cent for monthly changes but it is up to the CPI statistician to choose, based on personal judgement.
- The third modification is intended to overcome the problem of using small samples. When using a small sample, the impact of one observation on the distances between the quartiles and the median might be considered to be too great. In practice, the sample sizes for many elementary aggregates will be small. To improve the usefulness of this method, the samples from several similar elementary aggregates can be combined. In this regard, elementary aggregates can be considered similar if their prices are believed to exhibit similar behaviour.

For a more detailed explanation of this approach the reader is directed to Hidiroglou and Berthelot (1986)[54]

The Tukey Algorithm

12.35 The Tukey algorithm overcomes the problem of having many price relatives indicating no price movement included in the sample. The first step is to sort the sample of price relatives. The highest and lowest 5 per cent are flagged for examination as possible errors or outliers and removed from further calculation. All observations with no price movement are also removed from the sample before further calculations are done. The next step is to calculate the arithmetic mean (*AM*) of the remaining observations (call this the Tukey sample). This value is then used as the dividing value to separate the observations into two smaller samples: an upper and a lower set of price ratios. The arithmetic mean of each of these two samples is then calculated (AM_L, AM_U). The upper and lower Tukey limits (T_U, T_L) are then calculated for the Tukey set as:

$$T_U = AM + 2.5(AM_U - AM)$$
$$T_L = AM - 2.5(AM - AM_L)$$

12.36 All observations that are greater than T_U or less than T_L are flagged as possible errors or outliers.

12.37 As this method excludes all observations with no price movement, the calculated limits are unlikely to be close to the mean. Therefore there will be no necessity to impose a minimum difference as in the first method. However, the problem of requiring a reasonably large number of observations in the sample remains. Again it may be necessary to combine the samples of similar elementary aggregates. Worked example (3) in Appendix 12.1 shows that 5 observations would have been flagged by this method in comparison to 18 observations by the previous method based on the modified use of median and quartile values.

12.38 Statistical methods of filtering have an advantage over simple filtering in that the limits are set by the data and they can be re-calculated over time. The disadvantage is that filtering cannot be done until sufficient quantities of data have been collated, unless the index compiler uses approximations from past experience. The processes can be repeated as additional prices are received. Compilers should aim to set filters so that most of the records flagged as potential errors do turn out to be errors (or outliers requiring explanation). The aim of all these methods of filtering is to indicate which records require examination, not to flag records for deletion from the sample. Each price movement should be checked for credibility and that it is representative. Only if the movement is considered to be an error or unrepresentative should modification of the movement be considered. There should not be a presumption that an outlier is "wrong until proven right". To put it the other way, outliers are "innocent until proved guilty".

Dealing with outliers

12.39 As already indicated above, the detection of price observations which are outliers may be conducted through an examination not only of price levels but also of price movements. In this case outliers can be defined as price movements that are exceptionally large compared with the majority of movements. The movements will have been verified as being based on correctly collected and recorded data but may not be representative of the behaviour of the section of the market that they are meant to represent. This leads to the concern that a different sample would have produced a greatly different and more representative average price movement.

12.40 The strategy adopted by most statistical institutes is to reduce the impact of exceptional

[54] "Statistical editing and imputation for periodic business surveys", Survey Methodology, Volume 12, No 1, pp 73-83

observations rather than exclude them from the index. The general rule should be to include verified prices; the exception should be to modify them.

12.41 The tests for outliers are the same as those for identifying potential errors, as described in the section on data editing. Outliers can be determined by comparing the price movement against defined allowable limits. These may be either pre-determined numerically or pre-defined based on statistical tests. The CPI Manual discusses identifying outliers in chapter 9 (paragraphs 9.146 to 9.165). Guidelines on the preferred methods should be provided by Headquarters.

12.42 If outliers are to be modified, they are usually modified to lie on the pre-defined boundaries of acceptable movement or to be imputed by the movement of a suitable sample of prices. The CPI Manual urges caution when using automatic adjustment of outlier movements. Automatic adjustment implies the index compiler has no further information to assist in making an appropriate decision and this is not always the case. Experience suggests that the most likely candidates for adjustment are outliers belonging to small samples in highly weighted elementary aggregates but such guidance should not be followed blindly. The index compiler should consider each case on its individual merits, following agreed guidelines.

12.43 It is worth re-emphasising that price collectors and their supervisors are responsible for providing as much information as possible about the reasons for extreme price movements or levels and why they accepted the price quote as valid. In addition to checking for simple accuracy, supervisors should also be comparing the price movements for equivalent products obtained by all their collectors.

Missing prices

12.44 Treatment of missing prices is dealt with in more detail in Chapter 7. This short section discusses ways of minimising the occurrence of missing observations.

- Maintain the relevance of the sample of items priced. As part of the longer term maintenance of price samples, items and locations for which prices are missing can be examined for common patterns. For instance, if many retailers are missing the same item, there may be some supply problem of which no single retailer is aware. This may be an indicator that an item will have to be replaced. If the number of regularly missing items is growing then the sample itself might need to be reviewed. If a particular shop is recorded as having a relatively large number of missing prices it may no longer be an appropriate outlet for the particular items assigned to it, or the varieties of products whose prices are collected in the shop may need to be reviewed.
- Where prices are collected by means of a questionnaire sent to the shopkeeper, individual shopkeepers often follow a regular pattern - some return their price surveys promptly, others take some time. Staff should be encouraged to become familiar with these patterns. If the system for recording the return of these surveys also records the expected return date, then unexpected non-returns can be flagged even though the final deadline for return of survey forms has not passed. These shopkeepers can be contacted in advance of the final deadline to ensure that the survey form has not been forgotten. Early contact can reduce the number of prices still missing by the deadline. Shopkeepers that provide prices for heavily weighted items can also be monitored and contacted earlier rather than later.

Credibility checking

12.45 Credibility checking tests the reasonableness of the input data and the results obtained. Credibility checking of the results should take place after the checking of the numerical accuracy of the data in the early stages as described above. These early checks are the responsibility of the price collectors and their supervisors but also involve outlier detection at Headquarters. These early checks should discover all straightforward errors like incorrect coding, such as wrongly attributing a price as a sale price, and the incorrect recording of prices.

12.46 Dealing with other potential errors is not so straightforward. Results that fail a data check, such as exceeding the pre-defined movement limits described earlier, may be judged by the index compiler to be valid as a result of referring to other information such as market intelligence. Other potential errors might only be resolved after checking with the shopkeeper, if time allows.

12.47 If it is still possible with individual price quotations to re-survey the price or obtain a satisfactory explanation from the shopkeeper, then the query can be sent back to the price collector and the data can be flagged as being verified and then subsequently corrected if found to be an error. Even if it is not possible to check with the shopkeeper before the computation deadline, the shopkeeper could be questioned during the next regular visit, as the answer may assist the statistical office's

understanding of market behaviour for the particular product or industry. When a satisfactory explanation is not available, the CPI procedures should provide guidelines to aid the compiler in making a decision. For instance, the compiler could omit the price allowing the processing system to impute a price, or modify the price to keep the price change within a pre-defined limit, but this is best avoided and should be the exception to the rule. If prices are modified without verification from the shopkeeper it is recommended that price collectors are informed of potential problems during the next collection.

12.48 Statistical offices can minimise problems caused by unusual prices and price movements by training price collectors to recognise these situations and to check prices when first observed and to collect relevant explanatory information during the initial price collecting visit. Avoiding return visits or calls keeps costs down and also reduces the burden placed on shopkeepers.

Output editing of indices

12.49 Data output checking is concerned with ensuring that the calculated index movements are credible (that is, both the compilers and the users of the indices will accept the results). By this stage of the index production process the numerical accuracy of the input data should have been thoroughly checked. Consequently no further checking, at this level, should be required. However, accuracy of price collection is no guarantee that the collected prices are satisfactorily representative.

12.50 The major aims of the output editing of the indices are three-fold:

- To ensure that the prices collected are representative and provide a true indication of the average movement in prices.
- To ensure that the movements in the indices are consistent between themselves.
- To ensure that satisfactory analytical explanations can be given on publication.

Analytical tools

12.51 The calculated movements in the indices should be compared with expected movements. The expected movements can be derived from: the monitoring of business activity conducted as part of the CPI process; reference to the normal behaviour in prices due to seasonal change; information obtained from the business sector, particularly manufacturers, importers and wholesalers; forecasts of CPI movement produced by banks and other financial companies or statements of their expectations. Events which might be expected to influence price movements will include:

- Government intervention such as changes to retail taxes.
- Persistent changes to the exchange rate.
- Seasonal availability and demand.
- Pricing practices with new models.
- New manufacturers or sellers in the market.
- Regular but abnormal price changes, for instance tariffs relating to utility prices.

12.52 If the calculated movement in a particular index is inconsistent with the expected movement then the index compiler should try to find out why. Small differences in the size of the movement are not a worry, as expectations themselves will not necessarily be very accurate. But differences in the direction of movement, i.e. a significant increase instead of an expected fall, or vice versa), should always be investigated. The index compiler must be able to provide a satisfactory explanation whenever the calculated index movement differs greatly from expected movements. This applies whether the expected movements are derived internally within the NSIs or are publicly available forecasts from other organisations.

12.53 Contributions to changes in the annual inflation rate can provide a useful analytical tool for understanding movements in the CPI. The contribution of a component to a change in the all-items CPI over a given period of time is defined as the change that would have occurred in the all-items index if that component had undergone its observed change but all other component indices had remained frozen at their values at the start of the period (and all expenditure weights were unchanged). The effect of each component depends on both the size of its change and its weight. The formula for calculating the contribution of a component to the monthly change in the CPI is given in Chapter 14 of this Handbook.

12.54 The index compiler should also compare the calculated index movements from the various regions within the country for consistency. For instance, seasonal patterns should be consistent among the regions and be consistent with past patterns unless special factors have intervened such as an unusually bad drought in a particular region. It is also possible for products or services from different index categories to be affected similarly by various economic events (or, stated another way, they may experience the same supply and demand pressures). The index compiler should be aware of

these and compare their index movements for any unexpected differences. For example, unusually cold and wet weather is likely to reduce the supply of foods requiring warm dry weather and increase the demand for certain clothes such as rainwear.

Prioritisation

12.55 Filtering the various index movements to select which indices and prices should be examined in more detail is recommended as it is not normally practical or cost effective to check every index calculation given tight timescales and limited resources. Filtering by impact is a procedure worth considering. It compares the impact an individual price movement will have on the index to which it contributes, relative to some pre-determined value. This index may be the index for the elementary aggregate to which the price sample belongs, the overall CPI index, or any in-between aggregate index. The impact of a price change is calculated as its percentage change multiplied by the weight of the product within the index. The impact 'C_{it}' of a change in price from period t-1 to period t for product i can be expressed as:

$$C_{it} = w_{i(t-1)} \times \left(\frac{p_{it}}{P_{i(t-1)}} - 1 \right)$$

where:
$w_{i(t-1)}$ = weight in proportional terms (e.g. 0.05 for representing 5 per cent of the index) in the previous period
p_{it} = price in the current period
$p_{i(t-1)}$ = price in the previous period
C_{it} = impact (or change) in the current period.

It should be noted that the numerical impact will actually depend on the formula used for calculation of the elementary indices. Also the IT system may have difficulty in taking into account all types of corrections made (e.g. when adjusting for quality changes or including/linking in new products etc). Thus the equation above will normally provide only a general "approximation" which can only be used for guidance.

12.56 In practice, the weights for the previous period ($w_{i(t-1)}$) may not be available. Provided that the price relatives for all products priced within the level of the index being used for the comparison are of the same magnitude, then the nominal (or base period) weight (w_{i0}) could be used. In this case the relative values of the weights will not have changed significantly. If the w_i are believed to have changed relative to each other, then the nominal weights could be price-updated to calculate an estimate of the previous period weight:

$$w_{i(t-1)} = w_{i0} \times PR_{i(t-1)}$$

where $PR_{i(t-1)}$ = the price relative (defined as the ratio of the price in the previous period and the price in the base period) for item i. But the use of price updating clearly has its dangers.

12.57 The bottom line is that the effect on the monthly elementary index of each price change can be approximated as 1/n multiplied by the % monthly price change and, if the price statistician has explicit weights, 1/n will be replaced by these.

12.58 It should be noted that the effective weight of a price can be greatly increased if it is used to impute movements for missing observations. In these cases, calculation of an effective weight of the priced item for the previous period might not be practical. Summing the nominal weights of all prices involved in the imputation should provide a reasonable approximation.

12.59 Prices that cause an impact greater than a pre-determined value should be flagged for examination. As this method uses only the individual price from the current period, there is no need to wait until all prices have been collected before applying the test (unlike, say, the statistical filtering tests described earlier in the chapter).

12.60 Identifying potential errors with this method has several advantages:

- It focuses on the results.
- It provides the index compiler with information about contributions to change in the index (see Chapter 14).
- It helps to focus/allocate resources to where they are most efficient, i.e. where the compiler of the CPI gets most value for money (in terms of a better CPI).
- It helps to catch the big and really serious mistakes/errors with significant impact on the CPI, while the price statistician may leave/accept smaller potential errors if they don't have any significant effect.

12.61 This kind of analysis is often performed after the indices have been calculated. The index compiler may discover unexpected behaviour from a COICOP category, rather than simply from a price obtained from a specific outlet and this may need further investigation. Additionally, the procedure might alert the compiler to a problem with the sample itself which could require a redesign.

Appendix 12.1

Worked Example 1

12.1.1 Worked Example 1 demonstrates the statistical filtering method discussed in paragraphs 12.27 to 12.33 of this chapter. Table 12.1.1, column 1, shows the price ratios for the illustrative sample.

Table 12.1.1 Price relatives showing movement from previous period

Price Ratio	S_i	Flagged using PR	Flagged using S_i
0.8138	-0.20638	Extreme	Extreme
0.8525	-0.15161	Extreme	Extreme
0.8760	-0.12072	Extreme	Extreme
0.8990	-0.09205	OK	OK
0.9086	-0.08051	OK	OK
0.9135	-0.07471	OK	OK
0.9339	-0.05124	OK	OK
0.9414	-0.04286	OK	OK
0.9553	-0.02769	OK	OK
0.9608	-0.02180	OK	OK
0.9658	-0.01651	OK	OK
0.9668	-0.01546	OK	OK
0.9702	-0.01190	OK	OK
0.9724	-0.00962	OK	OK
0.9817	-0.00005	OK	OK
0.9818	0.00005	OK	OK
0.9843	0.00260	OK	OK
0.9869	0.00525	OK	OK
1.0034	0.02205	OK	OK
1.0050	0.02368	OK	OK
1.0061	0.02480	OK	OK
1.0301	0.04925	OK	OK
1.0571	0.07675	OK	OK
1.0824	0.10252	OK	OK
1.0909	0.11118	Extreme	Extreme
1.0931	0.11342	Extreme	Extreme
1.1300	0.15101	Extreme	Extreme
1.1550	0.17647	Extreme	Extreme
1.2296	0.25246	Extreme	Extreme
1.2304	0.25327	Extreme	Extreme

12.1.2 The first and third quartiles (R_{Q1} *and* R_{Q3}) and the median (R_M) can be obtained using the quartile function in Microsoft Excel. The average distance of the quartiles from the median (D_M) is defined as:

$D_M = (R_{Q3} - R_{Q1})/2$

The upper and lower limits are then calculated as:

$L_U = R_M + C \times D_M$; *and*

$L_L = R_M - C \times D_M$

where the multiplier C has been set equal to 2.

12.1.3 The results are shown in the "Series PR' column in Table 12.1.2.

Table 12.1.2 Parameters and derived limits

Parameter	Series PR	Series S_i
R_{Q1}	0.94488	-0.03907
R_M	0.98175	0.00000
R_{Q3}	1.05035	0.06988
D_M	0.05274	0.05447
C	2	2
L_L	0.87628	-0.10894
L_U	1.08723	0.10894

12.1.4 As described in paragraph 12.34 of this chapter, the price ratio series can be transformed to provide more equal weighting between negative and positive price movements. The transforms are repeated here as:

$$S_i = 1 - \frac{R_M}{R_i} \quad \text{if } 0 < R_i < R_M$$

$$S_i = \frac{R_i}{R_M} - 1 \quad \text{if } R_i \geq R_M$$

12.1.5 The transformed observations are shown in the column labelled 'Series S_i' in table 12.1.1. The quartiles, median and calculated limits for the transformed series are shown in the third column in table 12.1.2. The increased value for D_M for the transformed sample shows that the transformation has increased the distances for the price decreases while leaving the distances for positive movements the same.

12.1.6 The last two columns in table 12.1.2 show, respectively, the observations that would be flagged for further examination (indicated by the word 'extreme') for the original price ratios and the transformed price movements.

Worked Example 2

12.1.7 Worked Example 2 demonstrates the same statistical filtering method but with an additional 16 price ratios added to the sample. All the new price ratios show zero change. The same calculations are done but on a sample of 46 instead of 30 observations. Table 12.1.3 shows the sample of price ratios and the transformed price movements, as well as the observations flagged for further observations.

Table 12.1.4 shows the parameters and calculated limits.

Table 12.1.3 Price relatives showing movement from previous period

Price Ratio	S_i	Flagged using PR	Flagged using S_i
0.8138	-0.2288	Extreme	Extreme
0.8525	-0.1730	Extreme	Extreme
0.8760	-0.1416	Extreme	Extreme
0.8990	-0.1123	Extreme	Extreme
0.9086	-0.1006	Extreme	Extreme
0.9135	-0.0947	Extreme	Extreme
0.9339	-0.0708	Extreme	Extreme
0.9414	-0.0622	Extreme	Extreme
0.9553	-0.0468	Extreme	Extreme
0.9608	-0.0408	Extreme	Extreme
0.9658	-0.0354	OK	OK
0.9668	-0.0343	OK	OK
0.9702	-0.0307	OK	OK
0.9724	-0.0284	OK	OK
0.9817	-0.0186	OK	OK
0.9818	-0.0185	OK	OK
0.9843	-0.0160	OK	OK
0.9869	-0.0133	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0000	0.0000	OK	OK
1.0034	0.0034	OK	OK
1.0050	0.0050	OK	OK
1.0061	0.0061	OK	OK
1.0301	0.0301	OK	OK
1.0571	0.0571	Extreme	Extreme
1.0824	0.0824	Extreme	Extreme
1.0909	0.0909	Extreme	Extreme
1.0931	0.0931	Extreme	Extreme
1.1300	0.1300	Extreme	Extreme
1.1550	0.1550	Extreme	Extreme
1.2296	0.2296	Extreme	Extreme
1.2304	0.2304	Extreme	Extreme

Table 12.1.4 Parameters and derived limits

Parameter	Series PR	Series S_i
R_{Q1}	0.96765	-0.03343
R_M	1.00000	0.00000
R_{Q3}	1.00255	0.00255
D_M	0.01745	0.01799
C	2	2
L_L	0.96510	-0.03598
L_U	1.03490	0.03598

12.1.8 A comparison of the results from the two examples demonstrates the effect of having a significant number of observations with no price movement: The distance from the median (DM) is reduced and the number of observations flagged for further examination is significantly increased.

Worked Example 3

12.1.9 Worked Example 3 demonstrates the alternative statistical filtering method – the Tukey algorithm (see paragraphs 12.35 to 12.38 of this chapter). The sample from Worked Example 2 is used here to demonstrate the benefit of this method when the sample has a large proportion of price ratios indicating no movement. Table 12.1.5 presents the intermediate data stages in addition to the basic sample and the indicator for possible errors.

Table 12.1.5 Price relatives showing movement from previous period – Example 3

Price Relative	Less 5% tails and Less zero movement	T lower set	T upper set	Flagged as extreme
0.8138				Extreme
0.8525				Extreme
0.8760	0.8760	0.8760		Extreme
0.8990	0.8990	0.8990		OK
0.9086	0.9086	0.9086		OK
0.9135	0.9135	0.9135		OK
0.9339	0.9339	0.9339		OK
0.9414	0.9414	0.9414		OK
0.9553	0.9553	0.9553		OK
0.9608	0.9608	0.9608		OK
0.9658	0.9658	0.9658		OK
0.9668	0.9668	0.9668		OK
0.9702	0.9702	0.9702		OK
0.9724	0.9724	0.9724		OK
0.9817	0.9817	0.9817		OK
0.9818	0.9818	0.9818		OK
0.9843	0.9843	0.9843		OK

0.9869	0.9869	0.9869		OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0000				OK
1.0034	1.0034		1.0034	OK
1.0050	1.0050		1.0050	OK
1.0061	1.0061		1.0061	OK
1.0301	1.0301		1.0301	OK
1.0571	1.0571		1.0571	OK
1.0824	1.0824		1.0824	OK
1.0909	1.0909		1.0909	OK
1.0931	1.0931		1.0931	OK
1.1300	1.1300		1.1300	OK
1.1550	1.1550		1.1550	OK
1.2296				Extreme
1.2304				Extreme

12.1.10 The price ratios for the sample are shown in the first column. The first step was to remove the highest and lowest 5 per cent of price ratios. Five per cent of this sample equals 1.5 observations. This was rounded up to 2 observations. Observations with zero price movement were also removed. The remaining observations are shown in the second column. The arithmetic mean (AM) of the remaining set of observations is calculated. This value, along with other parameter calculations is shown in Table 12.1.6. The arithmetic means of the lower and upper sets of data are then calculated (labelled AM_L and AM_U respectively). The lower and upper data sets have been presented in columns 3 and 4, respectively, purely for explanatory purposes. The Tukey lower and upper limits are then calculated as:

$$T_L = AM - 2.5(AM - AM_L)$$
$$T_U = AM + 2.5(AM_U - AM)$$

The results are shown in table 12.1.6.

Table 12.1.6 Parameters and derived limits

Parameter	Value
AM	0.99429
AM_L	0.94990
AM_U	1.06531
T_L	0.88332
T_U	1.17184

12.1.11 Using this method, five observations would be selected for further examination - many fewer than the 18 selected in example 2.

CHAPTER 13

Sources of Errors and Bias in a CPI

Introduction

13.1 Chapter 11 of the CPI Manual summarises the types of sampling and non-sampling errors to which CPIs are subject, including the issue of bias in measurement. It also discusses the measurement of error and bias including the difficulty of making quantitative estimates, particularly for non-sampling error, and provides guidance on procedures to minimise errors and bias. It concludes by emphasising the importance of providing detailed descriptions of compilation methods and data sources and the sources and magnitude of sampling and non-sampling errors to enable users to understand the limitations of the index. The ILO Resolution, emphasising the latter point, states that "In order to ensure public confidence in the index, a full description of the data collection procedures and the index methodology should be prepared and made widely available" and that "The documentation should include …… a discussion of the accuracy of the index estimates".

Background

13.2 The literature on CPIs discusses, from several perspectives, the general types of potential error and bias, to which all price indices are subject. In this chapter three perspectives are presented.

- A summary of the general measurement problems, most of which have been illustrated in preceding chapters of the Handbook.
- A review of the arguments presented in various studies that attribute bias in CPIs to insufficiently accurate treatment of quality change, consumer substitution and other factors – the first two representing two of the most significant sources of potential bias in a CPI.
- A description of the main sources of sampling and non-sampling error that arise in estimating a CPI from a set of samples relating to commodities (products, varieties, items), outlets, households. These issues exist in all statistical series based on samples but there are some unique features in CPIs which make some aspects of sampling a challenge.

13.3 This chapter lists the potential errors and biases that can occur in a CPI and also points to ways of minimising their impact. It represents a convenient summary of the relevant issues raised in earlier chapters and provides references to where advice on solutions can be found.

Summary of General Measurement Problems

13.4 The accuracy of a CPI refers not just to the measurement of statistical precision, as indicated by the mean squared error of the estimator of the index level or annual percentage change. There are several other indicators of accuracy relating, for example, to the relevance of the statistical framework, issues arising from measurement and processing errors and problems generated by non-response such as the non-availability of prices and the modelling used for imputing missing prices and for the introduction of new or replacement items. Additionally, in practice the measurement of accuracy is often constrained by methodological issues and limited resources. This section provides an overview of the general measurement problems associated with the compilation of a CPI and the related issues which need to be addressed by the compiler.

Aggregation

Sub-indices for different reference populations

13.5 Households differ from one another in their consumption patterns: they will shop in different outlets, purchase different varieties of a product and as a result will often pay different prices even for the identical products. The total CPI is an average measure of the price change experienced by the reference population which may be quite different from the price change experienced by a single household in the population or even for specific population subgroups. Empirical studies have shown evidence of variation in inflation rates across households based on income, age of household head, family structures, areas of residence, etc.

13.6 When a CPI for a specific sub-group of the population is consistently higher or lower for several

periods over time, there is merit in producing and publishing these indices, especially for such uses as indexation of social security benefits and measuring changes in real income, etc. But the fact that prices data are collected from retail stores and other outlets and not directly from households gives rise to a major caveat in the construction of such indices which are intended to represent sub-populations as defined by socio-economic characteristics. This is because variations are likely to exist among households and household groups with respect to the particular types and qualities of goods and services they purchase and the type of shops they frequent. It is difficult with a household budget survey to associate the economic and demographic characteristics of households with the actual items purchased and prices being paid. Such indices are normally computed through a re-weighting of the prices collected through the normal CPI price collection exercise, to reflect the different expenditure patterns, but not the different brands purchased and shops visited by the groups in question.

13.7 Some statistical offices compute a CPI with a restricted reference population. For example, the reference population of a CPI used for indexation of state pensions and social security benefits is sometimes restricted to private households (i.e. excluding those living in institutions such as prisons, retirement homes or student accommodation) and excludes pensioner households which derive the majority of their total income from state pensions and benefits and high-income households, normally defined as those households whose income is above a certain upper percentile of all household incomes.

13.8 As Chapter 11 on Special Indices notes, indices constructed to represent sub-groups of the population have been criticised for their frequent lack of specificity which can reduce their relevance.

Plutocratic weights

13.9 The process of deriving weights for goods and services in the consumer basket by reference to expenditure patterns derived in large part from household budget surveys is described In Chapter 4. This approach, known as *plutocratic weighting*, attributes weights to each household according to their share of total expenditure, implying that richer households receive more weight. An alternative valid approach in economic theory, known as a *democratic* weighting scheme, attributes equal weight to each household in the population. Empirical research on this issue has not been conclusive on whether different weighting schemes can lead to substantially different numerical differences in the measured inflation rate.

Seasonality

13.10 The objective of a CPI using a traditional Laspeyres approach is to measure the change between two periods (usually monthly) in the expenditure necessary for the acquisition of a fixed annual basket of goods and services, according to expenditure patterns in the base period. However, the consumer does not purchase a standard fixed basket in all months of the year, but purchases a basket which changes with the seasons of the year[55]. Expenditure patterns may be different because of the supply-side (i.e. changing quantities are offered at different seasons such as at harvest time) or the demand-side (i.e. consumers may seek differential quantities for seasonal reasons such as buying warm clothes in winter). The two consumption groups in which the greatest concentration of seasonal goods is usually to be found are clothing and footwear and fruits and vegetables. Chapters 9 and 11 describe the complicated issues relating to weight allocation, price measurement and index aggregation of seasonal goods.

Annual Prices

13.11 Some services provided to households may be subject to annual rather than monthly payments. For some services, such as school fees and municipal services, the annual payment may be fixed at the same time for all consumers whilst for other services, in particular those for annual services that have different expiry dates, such as insurance services and registration fees, the annual (renewal) payments occur at different times of the year so that customers will have paid different prices for the service depending on whether they paid before or after a price increase. The common problem in calculating price indices for services where the price expiration will vary between consumers is how to calculate a monthly index. Chapter 9 on Special Cases provides some guidance with illustrative examples.

Differential prices based on quantities consumed

13.12 The price of services per unit supplied to households may change according to the quantities that are consumed. Examples are major utilities like electricity, water or gas. Differential pricing is sometimes introduced by suppliers in order to

[55] Expenditure patterns may be different because of the supply-side (i.e. changing quantities are offered at different seasons such as at harvest time) or the demand-side (i.e. consumers may seek differential quantities for seasonal reasons such as buying warm clothes in the winter). The two consumption groups in which the greatest concentration of seasonal goods is usually to be found are clothing and footwear and fruit and vegetables.

encourage conservation of natural resources, whereas other suppliers may provide bulk-purchase discounts where the unit price falls in relation to the quantities purchased. Whereas for most goods and services there is identity between the average price for a unit and the marginal price for the last unit, there is no such identity in these cases. The solution that may be adopted is to attempt to collect the data on the distribution of consumption by the household in the base period to generate a series of consumer profiles which can then be used for calculating average unit prices for different levels of consumption. The necessary data for the current price measurement are: the pattern of consumption by households in the base period and the differential unit prices for each level of consumption. These data may be obtained from the suppliers of the services, such as the utility companies.

13.13 Similarly, differential prices may be offered to different consumers based on their economic and demographic characteristics. Differential tariffs by income of household head enables cross-subsiding of public services and may be found in areas of health services, childcare, education, etc.

13.14 The solution in all these cases is similar to the one presented for annual prices and again is covered in Chapter 9.

Consumer Durables

13.15 The treatment of consumer durables is handled extensively in Chapter 9. It poses a complicated and intriguing conceptual and practical price measurement problem. A price index for consumer durables should measure the price change over time of a fixed basket of durables but the methodology will depend on the underlying conceptual basis of the index. Under the *acquisition* approach the total value of all goods and services delivered (i.e. acquired) during a given period, whether or not they were wholly paid for or consumed during the period, is measured and reflected in the index. With the *payments* approach**,** the index is compiled on the basis of the total payments made for goods and services during a given period, whether or not they were delivered to the household. Finally, the *user cost (*or *consumption)* approach takes account of the total cost during a given period of all goods and services consumed during that period. The distinction between the three approaches is particularly important for purchases financed by some form of credit, notably major durable goods and housing. These are acquired at a certain point of time, used over a considerable number of years, and may be paid for, at least partly, some time after they are acquired, often in a series of instalments. In essence, putting the above options more succinctly, the choice of adopted approach in compiling the CPI is between a basket of new purchases of durables in the base period**,** payments in the base period for already existing durables of the household or the expenditure on a basket of services supplied by these durables in the base period. It is possible to construct different types of price index for each of these approaches, each being appropriate to particular uses of the CPI. Different methods will require different expenditure data in the base period and price data in the current one. Housing usually represents the consumer durable with the largest expenditure on durables and is one where there remains a lack of consensus on which is the appropriate approach to adopt in a CPI. Issues relating to housing are covered in Chapter 9. In practice, the use of a CPI for many purposes can lead to compromises in conceptual purity. For example, some CPIs comprise a mixture of the acquisition approach and, for housing, either the payments or user cost approach.

Bias in a CPI

13.16 This section reviews the categories of error, either in pricing or in index construction, which can lead to bias in the CPI. The emphasis here is on the categorisation of errors, along with a consideration of their likely size, rather than on methods to reduce or eliminate the errors.

13.17 The four categories of bias listed by the Boskin Commission in 1996 are: upper-level substitution bias; elementary aggregate bias; quality change and new goods bias; and new outlet bias.

13.18 It is important to note that an evaluation of a CPI for potential sources of bias is only meaningful against an appropriate benchmark, that is, the conceptual basis of the index. During the course of this analysis, a number of dilemmas relating to conflicting conceptual needs implicitly arise. Added to this are the practical problems of measurement. No single inflation measure can fully satisfy a diverse range of user needs. However, different target indices can present compilers with similar issues of practical measurement which lead to common solutions despite different conceptual bases and analytical frameworks.

Upper-level substitution bias

13.19 Upper-level substitution bias arises when CPIs aiming to measure the cost of living, use a Laspeyres-type formula which in reality only provides an upper bound on a cost-of-living index under certain assumptions about consumer

behaviour. When prices change, consumers tend to shift their purchases toward those goods and services whose relative prices have decreased, thereby reducing any adverse consequences of the price changes on their cost of living. A fixed-basket index does not take account of this substitution effect.

13.20 Empirical studies have shown that the existence of an upward bias resulting from use of the Laspeyres formula is demonstrated consistently but indicates that the bias on the measured rate of inflation will generally be small. However, the impact can vary and is sometimes significant, depending on such factors as the rate of change in consumer spending habits.

13.21 The concept of upper-level substitution bias has been derived and discussed in the context of cost-of-living index theory, but an equivalent bias may be defined from the perspective of the pure price index. If the Fisher ideal (or other superlative index) is judged preferable on the basis of its symmetric treatment of base period and current period expenditure patterns, then the difference between that index and a Laspeyres could be interpreted as a measure of *representativity bias*. A similar argument could be applied with respect to lower-level substitution bias within elementary index cells.

13.22 Further discussion is presented in Chapter 10 of this Handbook.

Elementary aggregate bias

13.23 An elementary index in the CPI is biased if the conceptual basis of the methodology used departs from the measurement objective. Elementary aggregate bias can be divided into two components: *formula bias* and *lower-level substitution* bias. The two forms of bias can be distinguished according to the objective of the elementary index. For instance, the term "formula bias" can be used here to denote a situation in which the elementary index formula has an upward bias relative to the pure price index. On the other hand when the measurement objective is a cost-of-living index, the elementary index formula is said to suffer from lower-level substitution bias (or within-stratum substitution bias) if it does not reflect consumer substitution between the items contained in that index cell.

13.24 Chapter 10 on Index Calculation discusses the characteristics of alternative elementary index formulae. A key result is that the Carli formula for the arithmetic average of price relatives has an upward bias relative to the trend in average item prices. In particular the Carli suffers from lack of transitivity i.e. when prices return to an earlier level the chained index doesn't. Consequently, it is a formula to be avoided and some judge that it should be prohibited.

13.25 The ratio of arithmetic averages (Dutot) and geometric mean (Jevons) formulae eliminate formula bias as defined above but are not free from problems. For instance Dutot is sensitive to changes in the units of measurement (it does not pass the commensurability test). Jevons, on the other hand has some good axiomatic properties but, in an economic interpretation, strictly speaking is not a fixed basket index since it implicitly allows quantities to change in inverse proportions to changes in relative prices. In view of this it may not be considered appropriate for the construction of a pure price index.

13.26 When item prices within the elementary aggregate do not change at a uniform rate, the differences between the two formulae - Dutot and Jevons - provide a way of evaluating the potential importance of lower-level substitution bias. The Jevons formula is exact for a cost-of-living index if consumers follow the Cobb-Douglas behavioural model with an elasticity of substitution of one, whereas the Dutot formula corresponds to zero-substitution behaviour. Thus, if the goal is to approximate a cost of living index, the geometric mean formula is generally judged to be preferable, although in reality as the elasticity of substitution can vary between zero and infinity, depending on the product, the geometric mean is still not totally unbiased.

13.27 The extent of any other type of elementary aggregate bias will depend on a number of factors, including statistical design issues such as the homogeneity of the elementary aggregates, the variance of prices in the base month and, in a more practical dimension, the extent to which the price collection follows generic or loose item descriptions rather than tight item descriptions. Also, as with upper level substitution bias, elementary aggregate bias will vary with the overall level of inflation in the economy if there is a correlation between absolute and relative price changes.

13.28 The method used by an NSI for sampling items within a category will determine the effectiveness of formula choice in dealing with lower-level substitution bias. For example, if only a single representative item is chosen to represent the category, the index formula will fail to reflect the consumer response to any relative price change in the universe of items. More generally, a CPI using the Jevons formula suffers from an upward bias in small samples, so lower-level substitution bias may

be underestimated in empirical comparisons of the geometric mean with other index formulae. The impact of formula choice can be estimated with some degree of precision over a given historical period. Any corresponding bias, however, can be estimated only by assuming that the geometric mean or other functional form successfully approximates the index's measurement objective.

Quality change and new products bias

Quality change

13.29 The quality change problem involves trying to measure price changes for products which exhibit quality changes. The old item is no longer available, but a replacement or alternative one is on sale and priced by the collector. If the effect of quality change on price is, on average, either to reduce or increase the price, or the quality is improving or deteriorating but this is not reflected in a change in price, then a bias will result if the prices are compared without a quality adjustment, in other words, if the products were treated as comparable.

13.30 Unlike substitution bias, which can be estimated by a comparison of alternative formulae, quality change bias must be analysed on a product-by-product basis. Products and their associated index components are likely to experience widely varying rates of quality change over time. Moreover, the methods used for quality adjustment, described in Chapter 7 on Substitution and Quality Change, will also vary. If the adjustment process is inappropriate, there will be an error, and if the errors are in a systematic direction, there will be a bias.

13.31 A crucial point to recognise is that the direction of overall quality change does not imply the same direction of any quality change bias. Critics sometimes assume that CPIs make little or no quality adjustment and that they must therefore overestimate price change in view of the many demonstrable improvements over time in the quality of goods and services. In reality, a great deal of indirect or implicit quality adjustment takes place. For any component index, the issue is whether the direct or indirect method chosen for quality adjustment overestimates or underestimates the relative quality of replacement items in the CPI sample. The resulting bias can be either positive or negative.

13.32 Empirical evidence on quality change bias has been based largely on extrapolation from individual studies of particular products. These individual studies may involve, for example, comparisons of hedonic regression indices with the corresponding CPI series or estimates of the value of some product improvement that has been ignored in CPI calculations. Although the majority of such studies have suggested upward rather than downward bias, the reliance on fragmentary evidence has led to criticism by observers who point to evidence of quality declines that have not been subjected to systematic analysis. This is particularly so given the fact that most of the studies undertaken to date relate to goods rather than services. With the latter it may be less obvious that there have been net improvements in quality.

13.33 For services, overall quality trends can also be a matter of subjective valuation. New technology has led to unambiguous improvements in the quality of many consumer durables and other goods. By contrast, in service sectors such as mail delivery, public transport and medical care, it can be difficult to evaluate changes in quality. Airline travel, for example, has become safer and faster but perhaps less comfortable and reliable in keeping to scheduled timetables in recent decades, and the lack of cross-sectional variation in these characteristics makes the use of hedonic or other quality adjustment problematic.

13.34 Further details on quality change are provided in Chapter 7.

New product bias

13.35 New product bias, like elementary aggregate bias, can be divided conceptually into two components. The first concerns the failure to bring new products into the CPI sample with sufficient speed. This can lead to upward bias if those new products later experience large price reductions that are not reflected in the index, for instance after the novelty value wears off or production costs reduce as a result of economies of scale. The second component, in the context of a cost-of-living index, is the welfare gain that consumers may experience when a new product appears. Clearly, the latter will not be viewed as a bias when the cost of living index is not stated to be the CPI's measurement objective.

13.36 New products can be: products that replace predecessor items, for example CDs replacing vinyl records and tapes; product varieties that widen the range of consumer choice, such as imported beers and ethnic restaurants; or products that represent wholly new categories of consumption, such as microwave ovens or mobile telephones. A useful distinction made in the Manual and in this Handbook is the distinction between evolutionary and revolutionary goods and services. Each benefits from different operational procedures to ensure that the CPI basket remains up-to-date and relevant.

13.37 In practice the most frequent way that new products enter the CPI sample is through forced replacement, when products disappear abruptly from shelves. Operational procedures are generally designed to reduce this because of the difficulties associated with imputing a base price when an item disappears from an outlet without warning and there is no opportunity for overlap pricing.

13.38 Like quality change bias, new product bias can be negative, for example, if the range of products decreases, leading to less choice and the unavailability of products for which there is a demand, or if the index fails to capture phases of rapid price increase for certain items. But most observers point to a net upward bias, the uncertainty relating to its magnitude.

13.39 Chapter 8 of this Handbook addresses the issues associated with new products and, together with Chapter 7 on Substitution and Quality change, provides comprehensive guidance.

New outlet bias

13.40 Conceptually, new outlet bias is identical to new product bias. It arises because of the failure to reflect either price changes in new outlets not yet sampled, or the welfare gain to consumers when new outlets appear and provides greater choice and a different level of service. A failure to maintain a fully up-to-date outlet sample can introduce bias because the new outlets will often be distinctive in their pricing or service policy.

13.41 Outlet disappearance is normally less frequent than product disappearance. Nonetheless it is important for NSIs to have procedures in place not only for selecting and recruiting replacements but also for comparing prices data at the new and old outlets. The procedures should ensure that different prices at the new outlet which are due to differences in quality of service or in the detailed item specifications do not result in changes in the index. Chapter 7 provides further guidance on these types of bias and should be read in conjunction with Chapter 5 on Sampling.

Estimates of bias

13.42 The 1996 Boskin Commission report gave a range of estimates for the total upward bias in the United States CPI of 0.8 to 1.6 percentage points. This assumed that the target index was an unconstrained cost-of-living index. It is based on a straightforward summation of the component bias estimates. Most detailed studies conclude that CPI bias is usually in an upward direction, although there have been numerous criticisms of that conclusion.

13.43 As noted earlier, most statistical agencies do not have the capacity to compute CPI bias estimates on a regular basis. Many of the same obstacles that prevent the elimination of bias also stand in the way of estimating its numerical effect. These include the lack of complete data on product-level consumer preferences and spending behaviour, and the inability to observe and value all differences in quality among items in the marketplace. Without such information it is impossible to calculate a true cost-of-living index, and measure the divergence between its rate of growth and the growth rate of a traditional Laspeyres-type CPI.

Sampling and Non-sampling Errors

13.44 The objective of a sample survey is to compute estimates of agreed population characteristics. In the context of a CPI this is the average cost of a fixed basket of goods and services purchased for consumption by the reference population of households. Such estimates will rarely exactly match the population characteristics. There will always be some error. Two broad categories can be distinguished: sampling errors and non-sampling errors[56].

Sampling errors

13.45 *Sampling errors* occur because a CPI is an estimate based on samples and not on a complete enumeration of the purchases of the populations involved. Statistical offices usually adopt a fixed weight CPI as the object of estimation. A fixed weight index can be seen as a weighted average of sub-indices of commodity groups, with weights being expenditure shares. The estimation procedures that most statistical offices apply to a CPI involve different kinds of samples, most particularly:

- For each commodity *group*, a sample of commodities to calculate the price index of the commodity group.
- For each commodity, a sample of outlets to calculate the elementary price index of the commodity from individual price observations.

[56] It can be noted that the CPI Manual (Ch. 11 Errors and Bias, paragraph 17) presents a distinction between errors and bias for the purpose of estimation. When using the results from a sample to estimate a population parameter, both error and bias affect the accuracy of the results. Yet there is also a distinction in statistical literature between types of error according to their source: sampling versus non-sampling error. Although they are both described as errors, the distinction remains that if their magnitude cannot be estimated from the sample itself, then they are biases. According to this distinction, non-sampling errors may be considered biases.

- A sample of households for the estimation of the average expenditure shares of the commodity groups, sometimes via estimates from national accounts.

13.46 The sampling error can be split into selection error and estimation error.

- *Selection error* occurs when the actual selection probabilities deviate from the selection probabilities as specified in the sample design.
- *Estimation error* denotes the effect caused by using a sample based on a random selection procedure. In theory, every new selection of a sample will result in different elements and in a different value of the estimator.

13.47 *Estimation error* can be controlled by means of the sampling design. For example, by increasing the sample size, or by taking selection probabilities proportional to some well-chosen auxiliary variable, the error in the estimated CPI can be reduced.

13.48 Three probability sampling designs are used extensively in survey practice: *simple random* sampling, *probability proportional to size* (PPS) sampling, and *stratified* sampling with simple random sampling or PPS sampling applied within each stratum. Because appropriate sampling frames are lacking for a CPI, samples are frequently obtained by non-probability methods. *Judgmental* (or expert choice) sampling is one form of non-random selection. A more sophisticated non-probability method is *quota sampling*. Another non-probability method is *cut-off* sampling, where part of the target population is deliberately excluded from the sample selection process. Because the selection is non-random, non-probability methods are, at least in theory, more prone to result in biased estimates. Empirical results nevertheless show that non-probability selection methods do not necessarily perform worse, in terms of the mean square error, than probability sampling techniques and are often a satisfactory option as long as the appropriate control procedures are in place.

13.49 The sampling variance associated with a CPI can in general be reduced by:

- Enlarging the samples of households, commodities and outlets, in proportion to their relative contribution to the variance. Experience suggests that the error resulting from commodity sampling is relatively high compared with the error resulting from outlet sampling. In this case, consideration should be given to increasing the sample size of commodities and reducing the sample size of outlets until an optimal allocation is achieved, whilst bearing in mind the financial and other resources available.
- The application of suitable stratifications to the various commodity groupings, with respect to similarity of price and price change.

13.50 The samples of commodities (and varieties) and outlets should be reviewed and updated periodically to ensure that they remain representative of the current buying habits of the index households. More advice is given in Chapter 5.

Non-sampling errors

13.51 *Non-sampling errors* can occur regardless of sample size. They can be subdivided into observation errors and non-observation errors.

13.52 *Observation errors* include such matters as over-coverage, response and processing errors. These are liable to occur during the process of obtaining and recording the basic observations or responses.

- *Over-coverage* refers to elements which are included in the survey but do not belong to the target population. For outlets, statistical offices are often confronted with imperfect sampling frames. In some countries, for instance, a business register is used as the sampling frame for outlets. In such a register, outlets are usually classified according to major activity and will contain outlets which are out of scope of the CPI, for instance, firms that sell to businesses rather than to households. In addition, there may be no detailed information on all outlets belonging to a specific business or on all the commodities sold by an outlet, even if the outlet is found in the register.
- *Response errors* in the Household Budget Survey (HBS) or consumer prices survey occur when the respondent does not understand the question, or does not give the correct answer, or when the interviewer or price collector makes an error in recording the answer. HBS respondents, for example, appear to systematically under-report expenditure on commodity groups such as tobacco and alcoholic beverages, which is the reason why estimates from HBSs are often supplemented by data from other sources, including administrative information from excise duty and other tax records.
- *Processing errors* relate to errors that can occur at the different stages of processing, such as coding, data entry, transfer and editing.

13.53 *Non-observation errors* include such things as under-coverage and non-response.

- *Under-coverage* occurs when elements in the target population do not appear in the sampling frame. The sampling frame of outlets often suffers from under-coverage, for instance as a result of the time-lag in enumerating new outlets and including them in a business register. In other instances readily available sampling frames with the necessary information on market shares etc are not available. For example, many statistical offices exclude purchases made on the internet and from mail order firms, due to lack of information on size of turnover and the customer database including the range of purchases by households.
- *Non-response errors* can arise from the failure to obtain the required prices data in a timely manner from all the outlets selected in the sample. If the price levels and rate at which prices change in the outlets from which prices have not been obtained differ from those which have, the results of the price survey will be biased. Non-response may also be encountered in an HBS. Total non-response occurs when households drawn in the sample refuse to cooperate entirely. Partial non-response occurs, for instance, when certain households refuse to give information about their expenditure on certain commodity groups, such as tobacco and alcohol.

13.54 Non-sampling errors can be reduced by applying appropriate quality assurance methods at all stages of the CPI compilation, as described in chapters 6, 7, 10 and 15, including the HBS that serves as the main source for CPI weights.

CHAPTER 14

Publication, Presentation, Analysis and Interpretation

Introduction

14.1 Paragraphs 71-80 of the 2003 ILO Resolution give the agreed international standards on dissemination. These should be strictly observed. Not to do so could undermine the integrity of the index and the associated statistical system. Chapter 13 of the Manual on Consumer Price Indices provides detailed guidelines in support of the Resolution.

14.2 In summary, the ILO Resolution states that the consumer price index should be produced and presented objectively, without political interference, and in such a way as to aid the understanding of users and meet their needs.

14.3 More specifically, as far as dissemination is concerned, the Resolution states that publication should be as soon as possible after the index reference period and in a readily accessible form to all users at the same time and to a timetable which is published well in advance. In addition, to facilitate transparency the Resolution states that the rules relating to publication of a CPI should be publicly available, including details of pre-release access and how the content of the press notice is determined. Guidelines on the detailed presentation of price indices in the CPI publication, including what and how the CPI should be presented in the statistical press notice, are also covered. As well as the figures themselves, background information on methodology should be provided to aid analysis and interpretation. Where a CPI figure can be revised, revisions should be clearly labelled and follow a published revisions policy.

14.4 The underlying principle is that responsibility for the statistics and their presentation rests with the National Statistics Institute (NSI). Decisions about the content of the statistical press notice should be professional decisions which take into account the needs of users and the confidentiality of data suppliers. Publication should be timely and follow a fixed timetable which is determined by operational requirements. Any non-compliance with published guidelines and procedures should be documented with a public explanation in order to protect professional integrity.

14.5 Another principle underlying release practices is that the CPI statistical press notice should be separate from any related political statements referring to government policies.

14.6 Additional frameworks have been produced which support the above principles and provide mechanisms for enhancing dissemination standards. NSIs may wish to draw on these. They include the International Monetary Fund's General Data Dissemination System (GDDS) and Special Data Dissemination Standard (SDDS)[57].

Timing of publication

14.7 The timing of publication of the index will generally be determined by reference to the price collection period. The decision on the timing of publication will involve a trade-off between achieving the earliest possible release and the need to quality assure and check the data and index calculation to reduce the risk of errors, and to provide users with a detailed analysis to assist interpretation. Other operational considerations will include managing the publication workload within the statistical office. For instance, an executive decision may need to be taken on whether there is the capacity within the office to publish the CPI and other key economic indicators on the same day. Users should be consulted to gauge their preferences. For instance, it will be necessary to take into account their capacity to deal with large volumes of new data and, conversely, the advantage to them in receiving a coherent set of new economic data which provide a more comprehensive and up-to-date picture of what is happening in the economy. Judgements will need to be made by the

[57] The GDDS provides standards to guide the public dissemination of economic and financial data. The SDDS is designed specifically for those countries who seek access to international capital markets. Both have been designed to enhance the availability of timely and comprehensive statistics. The SDDS is designed to improve the functioning of financial markets.

statistical office and it is important that the statistical office's decisions are transparent, that they follow publicly available operational guidelines and that the arrangements are not subject to external manipulation.

14.8 Ideally, publication should be at a point in the week and at a time of day which allows for balanced comment by outside commentators within a short time of release.

Choice of publication day

14.9 To guard against any accusation that publication of unfavourable data is being withheld or delayed for political reasons or being deliberately hidden by being timed to coincide with other announcements, a set formula relating the publication date to the price reference date of the latest index number is recommended. For example, this could be a set number of days after the price collection period but with some flexibility to allow for operational issues relating to public holidays and the fact that the number of days in a month varies. This can be expressed in terms of a formulaic approach based on working days, for example 15 working days after price collection or 20 working days if the period includes a public holiday. It may be helpful for publication to fall on the same working day of the week as this may be more convenient for users. It may also make the handling of publication workloads at the statistical office more manageable. Operational issues arising from public holidays may occasionally require deviations from the usual schedule and should be explained. For example, this might apply if the normal schedule would mean that data were released on a public holiday when neither staff from the NSI nor users would normally be working

Choice of publication time

14.10 The CPI can be a market sensitive statistic and it should be released at a set time of the day. Where circumstances warrant, consideration should also be given to its release early in the day - when the financial markets open - to allow the latter to take the latest figures into account when trading begins and to reduce uncertainty on the day. It should be noted that there are clearly presentational and practical advantages in treating all market sensitive data - whether the CPI, the latest unemployment figures or GDP, say - in the same way. There is a strong case both from a presentational point of view and in terms of user convenience to publish all statistics at the same time of day (although not necessarily the same day of week) even where financial markets are not a major consideration.

Pre-announcement of release dates

14.11 It is good practice to set the CPI production timetable far in advance to help forward planning. This also facilitates the release of forward publication dates many months in advance, a practice which is helpful to users and increases transparency and trust. Operational judgements again come into play in deciding the precise pre-announcement timetable but the target should be to release publication dates at least three months in advance. This can be done by publishing the next three release dates in the current CPI statistical press notice, possibly supplemented by provisional release dates for a further three months. It helps transparency if any revisions to previously published "final" release dates are explained in the press notice. Again there is advantage in a standard approach to all market sensitive statistics.

14.12 The rules and any formula used for determining the price collection period should be published and, to assist analysis, the CPI statistical press notice should show the price collection period for the latest index number to be published. This will enable users to gauge which price increases are reflected in the published index.

14.13 As well as helping operational planning and providing transparency, the use of set rules or a formula relating the publication date to the price reference date of the latest index number helps guard against the accusation that publication of unfavourable data is being withheld or delayed for political reasons or being deliberately hidden by being timed to coincide with other announcements.

Pre-release access

14.14 A general principle underlying the publication of official statistics is that they are made equally available to all at the same time. However, in some statistical offices pre-release access to the CPI is given to selected recipients, such as the Prime Minister, Minister of Finance or Head of the Central Bank and their officials, strictly on a need-to-know basis to facilitate the process of good government.

14.15 Where this arrangement does apply it is strongly recommended that the number of individuals granted pre-release access should be strictly limited as should the period of pre-release access. Reasons for granting pre-release access may include: Ministers and officials being able to respond effectively to issues relating to the interpretation of the figures raised at the time of release; addressing government policy issues raised by the figures; and being able to take pre-emptive policy decisions

where the latest data endangers the well-being of the country, for example if an unexpected jump in inflation would otherwise lead to pressure on the national currency.

14.16 Pre-release access should be transparent and pre-announced. Transparency can be achieved by publishing the rules for determining pre-release and by the NSI maintaining an up-to-date list of named individuals (or their job titles) given pre-release access, and making this publicly available. In determining the rules consideration should be given to:

- Which person determines pre-release access (normally the director or chief statistician of the NSI).
- What factors determine such access (for instance, when required for operational or policy reasons such as setting interest rates or announcing increases in state benefits or when ministers are required to respond to latest inflation trends- see previous paragraph).
- The conditions that apply when pre-release access is granted, i.e. the rules that recipients have to abide by.
- The timing of pre-release access (normally expressed with reference to the number of hours or working days prior to publication of the Press Release).
- The statistics covered. The pre-release data set may be restricted to the headline CPI and key sub-indices, for instance where the full Press Release is not available at the time of pre-release because it is still being put together. To assist interpretation it may include a short summary of the main factors determining the latest index figure.

14.17 Appendix 14.1 gives an example of a "model" pre-release document used to disseminate figures before publication. It includes a re-statement in summary form of the conditions applying when pre-release is granted.

14.18 It is strongly recommended that the pre-release document should have the appropriate security marking together with an indication of when the markings no longer apply (usually on publication). For instance: "Market sensitive-PERSONAL-CONFIDENTIAL-STATISTICS UNTIL XX JANUARY 2009". Consideration should also be given to the use of "numbered" copies and circulating these in secured double envelopes which have been initialled and labelled "FOR THE PERSONAL ATTENTION OF XXXXX".

14.19 Where the pre-release figures are provisional because they are subject to further quality assurance prior to publication this should also be clearly stated. More general guidance on the presentation of provisional figures and subsequent revisions in the public Press Release is given later in this chapter.

14.20 In some countries the conditions applying to pre-release access and the responsibilities it places on pre-release recipients are stated in writing to individuals at the time of granting pre-release access. An example of a letter authorising pre-release access is given at Appendix 14.2. The advantage of this is that there can be no doubt that those who have pre-release access are fully aware of the responsibilities that this brings

14.21 Those being granted pre-release access can be asked to confirm that they accept the conditions that apply before receiving their first pre-release copy of the figures. Consideration should also be given to asking those with pre-release access to make a regular declaration, say once a year, that they still need such access and that they only use the information themselves for the purpose intended. Alternatively, pre-release recipients can be sent a letter reminding them of their responsibilities, the rules relating to pre-release circulation and the consequences of not following the rules.

14.22 These procedures reduce the risk of problems occurring and put the national statistics institute in a stronger position to take corrective action if any breaches of the pre-release arrangements occur.

Political and policy statements by ministers and their officials

14.23 It has already been mentioned in the introduction to this chapter that one of the recognised principles underlying the release of the CPI and other official statistics is that the statistical press notice should be separate from any related statements referring to government policies which Ministers may wish to make. Release of the latter prior to the release of the corresponding statistics should be discouraged, as such statements should be seen as a response to the statistics rather than as an early warning of the story those statistics tell.

14.24 Exceptionally, consideration may be given to including in the statistical press notice a factual statement on government policy if this helps to put the latest CPI figures in context. It is recommended that such factual statements are checked for accuracy with the appropriate policy official in the relevant Ministry.

Procedures on publication day

14.25 The CPI statistical press notice should be released in a controlled environment which provides access to all at the same time by whatever medium is used - whether on paper or electronically. This can be facilitated by making available printed copies of the press notice for collection from the statistical office at the time of publication and, where circumstances warrant and the necessary infrastructure exists, simultaneous release electronically on the internet. In the latter case, procedures need to be in place to prevent accidental early release. For instance, the relevant website pages could be prepared on an internal copy of the website ready to be copied on to the live website at the appropriate time.

Release under embargo to accredited journalists and analysts: lock-up arrangements

14.26 A "lock-up" arrangement may be used to provide the media with the opportunity to absorb and understand the latest CPI figures before their official release. These arrangements normally apply only to accredited news organisations with a proven need to be ready to brief and provide comment at the time of publication. This will be the case, for instance, where the figures are closely monitored by the Stock Market. Participants are locked in a secure briefing room under supervision for a short period before publication (half an hour, say) to absorb the figures and to draft their own briefing documents. At publication of the CPI they are then free to circulate their briefing by their chosen means (on paper, electronically or by telephone). Where countries have lock-up arrangements in place, the statisticians who have been responsible for compiling the figures usually attend to present the figures and answer any factual questions relating to them. A typical format for a lock-up briefing, which provides a model for national statistics institutes to follow and typically starts half an hour before publication, would be as follows:

1. Participants sign in and the room is made secure.
2. Mobile telephones are declared and switched off.
3. Where applicable, approved computer equipment is plugged in but modems not connected. The room should not allow access to any wireless networks.
4. The statistical press notice is handed out and the statistician gives a presentation and answers any factual questions relating to the statistics.
5. Participants use their remaining time to prepare their briefing.
6. Where applicable, a few minutes before publication Internet access is made available in readiness of publication but no reporting of figures takes place.
7. Participants report their stories at the time of publication via their chosen medium.

14.27 Access to lock-up facilities should be conditional on participants agreeing to follow the official procedures. As with the circulation of pre-release figures, attendees should be made aware of the conditions that they agree to in attending a lock-up facility.

Face-to-face briefing by statisticians

14.28 The statistician responsible for compiling the CPI should be encouraged to provide face-to-face briefing not just in a lock-up but after publication where there is a clear and legitimate demand. This needs to be conducted in a controlled environment and done objectively to protect the professional integrity of the NSI. Ground rules should be laid down and documented on the types of question that it is appropriate for the statistician to answer. The statistician may need training by a professional press officer. It is important that face-to-face briefing is restricted to analysis, commentary and presentation which facilitates a better understanding and does not comment directly on policy issues or promote political interests.

Format and content of statistical press notice

14.29 The statistical press notice should be in a fixed format which does not change frequently and only changes following a formal review process. The contents and type of analysis and commentary is a professional decision made by the statisticians taking into account user needs and the statistical precision and resilience of the data. Any changes in format are a decision for the statisticians and any major changes in the material to be included, for example the introduction of new sub-indices, should ideally be pre-announced in the preceding press notice to allow recipients to prepare themselves for analysing the new data.

14.30 There are no international guidelines covering the statistical content of a statistical press notice but

it is recommended that at a minimum the press notice should contain:

- The index level and annual percentage change for each of the latest six months both for the "all items" index and for key sub-indices.
- An analysis of the main factors impacting on the annual inflation rate and/or contributing to the change in the annual inflation rate.
- Background notes giving definitions, coverage and statistical methodologies; a statement on the statistical reliability (with standard errors where these have been computed); index reference dates; publication dates of the next three publications, say; and a statement of pre-release arrangements.

14.31 The listing of future price collection periods is best avoided and circulation of this information is best restricted to those within the national statistics institute who need to know for operational reasons. This is to prevent price collection periods influencing the timing of price increases, particularly for those goods and services whose prices are determined by government.

14.32 The statistical press notice may also contain:

- Percentage change over one month for the "all items" index and for key sub-indices.
- Annual and/or quarterly average indices and associated rates of change.
- Monthly average prices for selected goods and services.
- Graphical presentation of the results.
- A table of international comparisons.

14.33 The press notice should be published under the logo of the statistical office, should be dated and give the address of the statistical office and a telephone number for dealing with queries. An example of what such a press notice may look like is given at Appendix 14.3.

14.34 The statistical press notice may be supplemented with a short news release targeted at the popular media rather than expert analysts. This will be different in style and content from the main press notice, for example it may present the main story in the headline (e.g. "Price increase in fresh food leads to inflation rise") and have less analytical detail.

Early warning of methodological changes and planned revisions

14.35 It is recommended that planned methodological changes are pre-announced, for instance by a note in the CPI statistical press notice which immediately precedes the introduction of the change. Such a note should include a technical description of the change and why it has been made. Where this results in backward revisions, the revised back-series should be released not later than the introduction of the methodological change to enable users to compare the new and old series and gauge the impact of the change.

Scheduled and unscheduled revisions

14.36 Paragraph 2.39 of the CPI Manual states that, "most countries have deliberately adopted a policy of not revising the index once it has been published. This makes it more attractive for many purposes, especially those with financial consequences such as indexation. The lack of revisions may, perhaps, create a somewhat spurious impression of certainty, but it also seems to enhance the credibility and acceptability of the index".

14.37 Inevitably, there will be circumstances where a planned change in methodology is introduced, which could potentially result in significant changes in the index, or where, for instance, there is an alignment of the CPI classification to COICOP, which could result in sub-indices at Division level being affected. In such circumstances it is recommended that, where revisions are not allowed, indicative back series are published so that users have a comparable time series for analysis, and that these time series go back at least two years so that a full twelve-month set of annual inflation rates on the old and new basis is available to the user. It is also recommended that where a number of methodological changes are introduced a detailed reconciliation is published between the old and new series giving the numerical impact of each change separately. The indicative back-series should be designated with an appropriate footnote alongside the figures concerned, referring to the fact that it is not a revision to the official series but rather an indicative calculation of what the CPI would have been if constructed using the new methodology.

14.38 Where a CPI is revisable, similar procedures apply. A revised back-series to the point where the new methodology applies should be published, with an appropriate symbol placed alongside the figures concerned. If possible an extended indicative back-series should also be published, together with a detailed reconciliation, where needed by users. The procedures followed should be along the lines

described above but will also depend on whether a revision is scheduled.

14.39 "Scheduled" changes to the CPI should be managed systematically, pre-announced and reflected in publication plans including appropriate footnotes in the press notice.

14.40 "Unscheduled" revisions are those that do not fit into the normal cycle of revisions to the CPI or where the CPI is not normally revised. They can occur, for instance, due to unexpected new data or by newly-discovered errors in index compilation. In these instances, consideration should be given to publishing the revisions outside the normal publication cycle, particularly if they are significant and have an impact on interpretation and decision making. The latter is a matter of judgement and may need to be taken in conjunction with policy officials in other government departments and the Central Bank. In these instances pre-release access may be allowed, following the same rigorous procedures followed for pre-release circulation of the regular figures. The revisions should also be referred to in the next available CPI statistical press notice. As in the case of planned revisions, a comparison of the old and new series and sub-series should be given where a number of changes to individual CPI series are being introduced. Where there is a policy of not revising the index, new figures can be published as "indicative" figures of what the official CPI would have been if the revisions had been made.

Standard calculations and special presentations and analysis

Choice of calculation periods to be covered

14.41 In many countries, the "headline" rate of inflation is the percentage change in the CPI comparing the latest month with the same month one year ago. Thus, the inflation rate for February 2006 would be the CPI for February 2006 compared to the CPI for February 2005. We can refer to this in general as *m/(m-12)*, where *m* stands for month. In countries where inflation is relatively high, the focus is often on the monthly inflation rate, i.e. the percentage change in the index between consecutive months. This would be *m/(m-1)* using the above convention. Another frequent measure is the average index for the most recent 12-month period compared with the preceding 12-month period. We may refer to this as *y/(y-1)*, where the "*y*" stands for year.

14.42 The advantage of *m/(m-12)* is that it is very up-to-date. A sudden rise in the price of petrol, for example, will be immediately reflected in the CPI. The disadvantages are, firstly, that like any point-to-point change it can be volatile: if the price of petrol falls in the next month there is a "yo-yo" effect which may not be desirable for some purposes, even though it closely reflects actual changes in the market place. The second disadvantage is that it is heavily dependent not only on the index for the latest month but also on the index 12 months earlier. If, for example, petrol prices rose sharply in month (*m-12*) but did not do so in month *m*, there would appear to be a moderation of inflation which may not reflect the longer-term trend or the most recent price history where it is possible that the recent price increases in petrol may have been accelerating.

14.43 The monthly inflation rate, i.e. the percentage change in the index between consecutive months, can suffer from the same drawbacks as the annual inflation rate. In addition it can also be particularly vulnerable to seasonal price effects which may not always be fully factored into the CPI itself.

14.44 For these reasons, more stable measures of "underlying" or "core" inflation are frequently calculated. These typically may exclude seasonal fresh food items, volatile energy prices etc. (See Chapter 9 for further discussion of seasonal items and Chapter 11 for further discussion of measures of core inflation).

14.45 The annual average method, *y/(y-1)*, has the advantage of eliminating most of the volatility associated with *m/(m-12)*. However, it suffers from a sluggish reaction to the more recent movements in the CPI: the latest month's figure, for example, contributes only one-twelfth to the calculation of the average for the latest year. Moreover, the earlier index figure used in the calculation is two years old: the figure for (*m-24*) equally contributes one-twelfth to the average index for the year (*y-1*). Its advantage is that due to its relatively sluggish movements it is possible to make reasonably accurate forecasts of its value well before the month of publication. The reason for this is that 24 separate monthly index numbers feed into the calculation of this index: if, say, 21 of the 24 are already known, the effect of the remaining three is unlikely to make a large difference to the result – unless, of course, they turn out to be exceptional months.

14.46 Finally, some statistical offices also present quarterly measures: *q/(q-1)* (where *q* stands for a quarter) which compare the average of the index for the latest three months with the average of the index for the preceding three months. *q/(q-4)* is the average of the index for the latest three months compared with the average of the same three-month period one year earlier. The quarterly

method may be regarded as some sort of compromise between the monthly and annual measures, though it is subject to seasonal effects. If, for example, utility prices tend to be increased in January each year, then the index for the third quarter compared with the second quarter will not reflect this change.

14.47 The precise presentation of the CPI data in the statistical press notice will depend on user needs and on the limitations of the data. However, as well as the standard calculations already mentioned there can be a particularly strong case for providing supplementary presentations to enhance the scope for analysis and facilitate better understanding of what the latest figures indicate. In computing the associated calculations, issues may arise, for example if the calculation spans a change in base period. Issues of interpretation may also arise where, for example, there is a significant element of seasonality in the prices charged by retailers.

Calculation of percentage change between any two months

14.48 Typically, a conventional chain-linked index can be used to calculate changes between any two months after the base month. For example, if the all-items CPI for May 1988 is 106.2 and that for August 2002 is 176.4 then the change between these months is:

$$(176.4 / 106.2 - 1) \times 100\% = 66.1\%$$

14.49 However, if the base month changed in December 1990, then the series based on the previous base month, say December 1980, is used up to December 1990 and the series based on December 1990 is used for the remainder of the period. For example, if the indices for July 1990 and December 1990, based on December 1980, are 384.7 and 394.5 respectively, and that for July 1991, based on December 1990, is 101.8, then the change from July 1990 to July 1991 is:

$$(101.8 / 100 \times 394.5 / 384.7 - 1) \times 100\% = 4.4\%$$

14.50 This can be seen from table 14.1.

Table 14.1 Calculation of change in index when spanning a re-basing

Month/Year	Old series (Dec 1980=100)	New series (Dec 1990 =100)
July 1990	384.7	(384.7x100)/394.5=97.52
Dec 1990	394.5	100
July 1991		101.8
Then ((101.8/97.52)-1)x100 = 4.4%		

14.51 The CPI itself should always be quoted as a level relative to the latest base month (in this example December 1990 = 100). For instance, the CPI for August 2002 is 176.4.

Calculation of annual and quarterly averages

14.52 Users may be interested in annual and quarterly average indices in their own right. For example, they may be quoted in contracts or they may be used as deflators for the National Accounts or to set against other social or economic indicators and analytical purposes.

14.53 Annual average indices are defined as the arithmetic mean of the twelve monthly values for the year in question. It is common practice to use published rounded indices for their computation so that they can be replicated by users from published data:

$$I_{12av} = \frac{1}{12} \sum_{t=1}^{12} I_t$$

14.54 Quarterly indices are defined similarly. It should be noted that there will not usually be any year or quarter with an average index of exactly 100, if the indices are always calculated so that a particular month (in the previous section December 1990) equals 100.

14.55 The annual average inflation rate can be derived from the annual average indices as the change in the annual average index from the year before. For example, if for the all-items CPI for 2001 the annual average is 173.3, and if the annual average for 2000 is 170.3, then the percentage change is (173.3 - 170.3) /170.3 x 100 = 1.8%. The difference in the mathematics means that this will not in general exactly equal the average of the individual annual percentage changes for January, February, through to December, but in practice the difference should be small. The calculation based on the percentage change in the annual average indices has the advantage of transparency over the average of the individual annual percentage changes for each month as it is more easily replicable from published data. Either average figure will usually be closer to the change between the middle of the year and the middle of the previous year than to the changes between the beginning and end of each of the years.

Calculation of monthly average prices

14.56 A monthly average price provides users with a simple statistic which can be readily related to personal experience. For meaningful results, the items included in a particular average should be

reasonably homogeneous across all outlets and over time. For instance, it may not be very meaningful to calculate an annual average price for a category covering "Household Equipment" which may include anything from a gas cooker to a washing-up bowl or for "Cultural Services" where the services included range from the printing and developing of colour film, to renting a television, to the admission price for an historic monument. It may also be helpful to give the number of price quotes on which the average is based and some measure of dispersion, e.g. the standard deviation or inter-quartile range.

14.57 The average prices should be calculated in a similar way to the item indices. Thus, if an item index is built up from regional item indices, with regional weights, then the national average price for that item should be a weighted average of the regional average prices.

Indices for subgroups and special aggregates

14.58 In addition to the standard sub-indices published alongside the all-items CPI, which are compiled using the underlying expenditure classification such as COICOP, special indices can be computed to suit user requirements. For example, some statistical offices include separate indices in their press notices for goods and for services. These indices are calculated from the same item indices and same item weights used in the calculation of the standard published sub-indices. The difference is that the item indices are mapped to these special indices; aggregation then proceeds in the usual way. This is illustrated in Table 14.2.

Table 14.2 Aggregation of Special Indices

Items from CPI	Standard Indices	Special Indices (e.g. index 1=Items A1+B1)	Item weights (as % of All Items CPI)	Item Index
Item A1	Index A	Index 1	0.4	102
Item A2	Index A	Index 2	0.6	101
Item B1	Index B	Index 1	0.3	104
Item B2	Index B	Index 2	0.7	103

Standard Index A is calculated as:

(0.4x102+0.6x101)/(0.4+0.6) =101.40

Special Index 1(Items A1+B1) is calculated as:

(0.4x102+0.3x104)/(0.4+0.3) =102.86

14.59 Special Index 2 (Items A2+B2) would be calculated by the same method.

Contributions to changes in the annual inflation rate

14.60 Contributions to changes provide a powerful analytical tool for understanding movements in the CPI. The contribution of a component to a change in the all-items CPI over a given period of time is defined as the change that would have occurred in the all-items index if that component had undergone its observed change but all other component indices had remained frozen at their values at the start of the period (and all expenditure weights were unchanged). The effect of each component depends on both the size of its price change and its weight. The formula for calculating the contribution of a component to the monthly change in the CPI is given below. As the definition of the variables above makes clear, it is important that these calculations are performed using indices with the same base period (i.e. in the example following all index levels are based on the previous December = 100).

14.61 Contribution of component i to the monthly change in the all-items CPI =

$$\left(\frac{I_t^i}{I_{t-1}^i}-1\right)\times 100\times\frac{I_{t-1}^i}{I_{t-1}^a}\times\frac{w_t^i}{1000} \quad (1)$$

where:

I^a *= all-items CPI*

I^i_t *= index for component i (current base period) in month t*

W^i_t *= weight (parts per 1000) of component i in all-items CPI in month t*

14.62 The formula for calculating the contributions of components to the all-items CPI 12-month rate (i.e. the annual rate of change) is given in equation (2). Note that this calculation assumes, for illustrative purposes, that the CPI has a single chain-link in January each year, based on December=100.

14.63 Contribution of component i to annual change in all-items CPI =

$$\frac{w_{t-12}^i}{1000}\times\frac{\left(I_L^i-I_{t-12}^i\right)}{I_{t-12}^a}\times 100+\frac{w_t^i}{1000}\times\frac{\left(I_t^i-100\right)}{I_{t-12}^a}\times I_L^a \quad (2)$$

where, additionally:

I^i_t*-12 = index for component i (previous base period = 100) in month t*

I^i_L *= index for component i in 'Link' month (i.e. month when the current base period=100).*

14.64 If there is no change in weights between the two points in time for which the contribution to the

12-month rate is required, then formula (2) simplifies to:

Contribution of component *i* to 12-month change in all-items CPI =

$$\frac{w^i}{1000} \times \frac{\left(I_t^i - I_{t-12}^i\right)}{I_{t-12}^a} \times 100 \quad (3)$$

14.65 It should be noted that the sum of the contributions across all categories is equal to the overall inflation rate and that contributions can be negative as well as positive.

14.66 Figures 14.1 and 14.2 show two illustrative examples of how to apply these formulae in practice.

Internal purchasing power of national currency

14.67 Changes in the internal purchasing power of a national currency are the inverse of changes in the

Figure 14.1 Example of calculation when the weights change

Using formula (2) above, the contribution of housing to the all-items CPI 12-month rate for October 2003 can be calculated as shown below.

The published (chained) index values, based on December 1989=100, for housing and the all-items CPI are as follows:

Published (chained) index (Dec 1989=100)				
	Dec 2001	Oct 2002	Dec 2002	Oct 2003
Housing	218.4	232.8	236.7	248.3
All-items	173.3	177.9	178.4	182.6

In order to work out the contribution of housing to the all-items CPI 12-month rate for October 2003, it is necessary to "unchain" the indices so that they are based on the most recent December. This is done by dividing the current month's index by the previous December's figure. For instance, the housing index for December 2002 (the link month) is calculated as:

$$I_L^i = \frac{236.7}{218.4} \times 100 = 108.38$$

Performing this calculation for each of the dates gives the following set of unchained index values:

Unchained index based on previous December				
	Dec 2001	Oct 2002	Dec 2002	Oct 2003
Housing	100.00	106.59	108.38	104.90
All items	100.00	102.65	102.94	102.35

The contribution of housing to the 12-month rate for October 2003 can then be calculated as follows, given that the weights for housing in 2002 and 2003 are 199 and 203 parts per thousand respectively:

$$\text{Contribution} = \frac{199}{1000} \times \frac{(108.38 - 106.59)}{102.65} \times 100 + \frac{203}{1000} + \frac{(104.90 - 100)}{102.65} \times 102.94 = 1.34\%$$

Thus, housing contributed 1.34 percentage points to the all-items CPI 12-month rate in October 2003. The way that these contributions to the 12-month rate are usually used is as follows. For any given month (e.g. October 2003) the contribution of each group to the 12-month rate is calculated. This is also done for the previous month (September 2003 in this case). The October contribution less the September one is described as the contribution to the change in the all items 12-month rate between the two months. Thus taking the case where housing contributed 1.40 points to the 12-month change to September and 1.34 points to the 12-month change to October, then it contributed 1.34 -1.40 = -0.06 points to the change in the 12-month rate between September and October.

Figure 14.2 Example of calculation when the weights do not change

Using formula (3) above, the contribution of transport to the all-items CPI 12-month rate for October 2003 can be calculated as follows, where:

- The weight for transport is 72 parts per thousand.
- The transport index values for October 2002 and October 2003, based on December 1999=100, are 121.5 and 119.7 respectively.
- The all-items index values for October 2002 and October 2003 respectively are 118.1 and 120.5.

$$\text{Contribution of transport} = \frac{72}{1000} \times \frac{(119.7 - 121.5)}{118.1} \times 100 = -0.11\%$$

Thus transport contributed -0.11 percentage points to the percentage point change in the all-items rate.

price level: when prices go up, the amount which can be purchased with a given sum of money goes down and vice versa. When questions are asked regarding changes in the purchasing power of the national currency in terms of what the domestic consumer can buy, the indicator must be one which reflects movements in the prices of goods and services purchased by the domestic consumer, in other words the CPI based on the domestic concept. Continuity in the chosen indicator is also important. A few examples follow by way of illustration.

14.68 To find the internal purchasing power of the national currency in one month, given that it was 100 cents in a previous month, the calculation is:

$$100 \times \frac{\text{Earlier month's CPI}}{\text{Later month's CPI}}$$

14.69 For example, if the internal purchasing power of the currency is taken as 100 cents in January 1993, its purchasing power in August 2002 is:

$$100 \times \frac{137.9}{176.4} = 78.2 \text{ cents}$$

where the CPI for August 2002 is 176.4 and for January 1993 is 137.9.

14.70 In other words, purchasing power fell by 21.8 per cent (100-78.2) during the period in question. By inverting the numerator and denominator of the above equation, one could also say that it required 128 cents in August 2002 to buy what 100 cents could buy in January 1993.

14.71 All these calculations use chained indices on the same base month or year.

14.72 Comparisons between any two years may be made in the same way using the annual averages of the CPI. For example, if the purchasing power of the currency is taken as 100 cents in 1993, its purchasing power in 2002 is:

$$100 \times \frac{140.2}{175.4} = 79.9 \text{ cents}$$

where the average CPI for 2002 is 175.4 and that for 1993 is 140.2.

Rounding

14.73 It is common practice to calculate all CPI indices to maximum precision, and then round for publication. The precision of the calculation may be dictated by the pre-determined settings of the computer system, used for computing the CPI, as the position of data items (and hence the field size) has to be defined, implying that the indices will have to be stored at a certain precision level. Whatever the case, it is important that the price statistician is aware of the level of precision of the calculation. Rounding should take into account the statistical precision of the index and user needs. The most common practice is to round to one decimal place, but rounding to two decimal places is very useful for countries with low levels of inflation or where month-on-month inflation rates are of interest.

14.74 A policy is also needed for all derived statistics such as annual and quarterly average indices, one-month and 12-month percentage changes - in particular whether they are calculated to maximum precision or derived from published

Table 14.3 The impact of using rounded figures in calculating derived statistics

	Index level				12-month rate	
	Jul-01	Aug-01	Jul-02	Aug-02	Jul-02	Aug-02
Un-rounded						
Index A	171.44	171.96	174.75	175.34	1.9%	2.0%
Index B	163.55	164.14	165.44	165.65	1.2%	0.9%
Rounded						
Index A	171.4	172.0	174.8	175.3	2.0%	1.9%
Index B	163.6	164.1	165.4	165.7	1.1%	1.0%

rounded indices so that they can be replicated for transparency.

14.75 There are two approaches which can be used in the computation of derived statistics. One approach is to calculate derived statistics from un-rounded (and unpublished) monthly indices; the other is to use published rounded indices. The first approach limits the impact of rounding effects and ensures that future re-referencing of indices to a new base year will not lead to revisions to one-month and 12-month percentage changes. However, it means that the derived statistics cannot always be calculated from the published indices. Calculation from published indices might be considered desirable both for transparency and to allow users to be able to replicate calculations. The second approach is transparent in that all derived statistics can be linked back to the published indices. This may be considered particularly important given the wide range of uses to which the CPI may be put, including the indexation of state benefits and of private contracts. However, some serious rounding effects can occur when publishing rounded indices to one decimal place, and then calculating percentage changes from these rounded indices which are then themselves rounded to one decimal place.

14.76 This is illustrated by the example in Table 14.3. In this example, published rounded figures indicate that the inflation rates for two CPI series - A and B - have both fallen by 0.1 percentage points (from 2.0 to 1.9 and from 1.1 to 1.0 respectively). However, the picture based on un-rounded figures shows series A to have increased by 0.1 percentage points (from 1.9 to 2.0) and series B to have fallen by 0.3 percentage points (from 1.2 to 0.9).

14.77 The choice of which approach to use involves a trade-off between accuracy and transparency. For regularly published series it is normally recommended that un-rounded figures are used to maximise precision. It is important to let users know, by the use of appropriate footnotes, which method has been adopted.

Appendix 14.1 Pre-release figures and accompanying letter

MARKET SENSITIVE - PERSONAL-CONFIDENTIAL-STATISTICS UNTIL XX JANUARY 2008

To: XXXXXXXXXXXXXXX COPY NUMBER: XX

Copies: XXXX
XXXX

PRE-RELEASE FIGURES ON CONSUMER PRICE INDEX: DECEMBER 2007

The consumer price index (CPI) for December 2007 will be published at 9:30 am on Tuesday XX January 2008. Attached is a near final draft of the statistical press notice/enclosed are the key indices. [These are provisional figures/advance estimates and may be subject to revision prior to publication].

You are reminded that the Consumer Price Index is a market sensitive statistic to which you have pre-release access. The figures should not be passed on to another person and any attempt to profit from this information or encouraging others to do so could constitute a market abuse and lead to criminal prosecution.

Any accidental or wrongful release should be reported immediately and may lead to an enquiry. Wrongful release includes indications of the content, including descriptions such as “favourable” or “unfavourable”.

Please prevent inappropriate use by treating this information as strictly confidential.

CONSUMER PRICES DIVISION
XX JANUARY 2008.

		Consumer Price Index	
		Percentage Changes	
		over one Month	over 12 Months
20XX	August	X.X	X.X
	September	X.X	X.X
	October	X.X	X.X
	November	X.X	X.X
	December	X.X	X.X
Advance Estimate		X.X	X.X
	January	X.X	X.X

Appendix 14.2 Letter confirming pre-release recipients

CONSUMER PRICE INDEX: INCLUSION IN PRE-RELEASE CIRCULATION LIST.

This is to confirm that your name has been included in the pre-release circulation list for the Consumer Price Index statistical press notice/ the key indices. This/these will be sent to you XXX hours before publication, that is at XX o'clock on the XXX day before publication. You will be required to sign on receipt.

The figures are provisional figures/advanced estimates and may be subject to revision prior to publication].

You are reminded that the Consumer Price Index is a market sensitive statistic to which you have pre-release access. The figures should be kept in a secure place and should not be passed on to another person. Any attempt to profit from this information or encouraging others to do so could constitute a market abuse and lead to criminal prosecution.

Any accidental or wrongful release should be reported immediately and may lead to an enquiry. Wrongful release includes indications of the content, including descriptions such as "favourable" or "unfavourable".

Pre-release is granted on account of your current post. You should notify this office if you change posts as this may have an impact on your entitlement to pre-release access to the CPI.

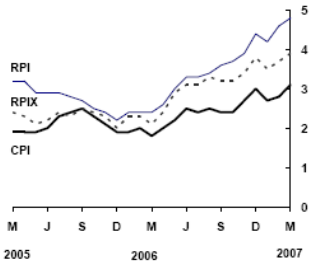
Please sign and return the attached form acknowledging that you accept the conditions.

Appendix 14.3 Statistical press notice

The example below is illustrative. The precise content and format of a press notice will depend on user needs. For example, the percentage change compared with the previous month might attract more attention than some sub-indices and this might present a strong argument for its inclusion on the front page.

Consumer price indices
XXXX 20XX

In the year to XXXX, the consumer price index (CPI) rose by X.X per cent, up from X.X per cent in the previous month, compared with a fall of around X per cent in March last year.



		Consumer prices index (CPI)		Selection of Sub-indices (e.g. fresh food)		Selection of special indices (e.g. seasonally adjusted)	
		Index (Jan 2005 =100)	Per cent change over 12 months	Index (Jan 2005 =100)	Per cent change over 12 months	Index (Jan 2005 =100)	Per cent change over 12 months
20XX	Oct	XXXX	X.X	XXXX	X.X	XXXX	X.X
	Nov	XXXX	X.X	XXXX	X.X	XXXX	X.X
	Dec	XXXX	X.X	XXXX	X.X	XXXX	X.X
20XX	Jan	XXXX	X.X	XXXX	X.X	XXXX	X.X
	Feb	XXXX	X.X	XXXX	X.X	XXXX	X.X
	Mar	XXXX	X.X	XXXX	X.X	XXXX	X.X

Main contributions to the change in the 12-month rate

The largest upward effect on the CPI annual rate came from XXXX, whose price increased by over X per cent in March, compared with a fall of around X per cent last year

A large downward effect on the CPI annual rate came from XXXX, whose price fell by X per cent in March, compared with an increase of X per cent a year earlier.

Publication date: XX 20XX

Issued by
XXXXXXXXX (name and address of Statistical Office)

Telephone XXXXX
Press Office XXXXX
Public Enquiries XXXXX
E-mail XXXXX

Geographical coverage
XXXX

Next publication date
XX XXXX 20XX

Page 1

BACKGROUND NOTES

Definition and coverage

1 The consumer price index (CPI) is the main official measure of consumer price inflation. It measures the price inflation experienced by the "typical consumer", based on the prices of a fixed basket of goods and services which would be purchased by the average consumer in……(the whole of the country/all urban areas/the capital city only)……..etc

Methodology

2 Prices are recorded for a large and representative selection of XXXX goods and services from XXXX shops and market stalls in XXXX shopping locations throughout the country. XXXX price quotes are collected each month……..etc

Reliability

3 The "All Items" Index is considered accurate to XX decimal place ……etc.

Reference date and future publication dates

4 This release includes the XXXX, collected on XX XXXX. Future publication dates are XXXX, XXXX, XXXX, XXXX, XXXX and XXXX.

Pre-release access

5 In line with established arrangements ……etc.

Further information

6 A more detailed quality report for this First Release is available from/at……etc

7 A fuller description of how the CPI is compiled is given in the Consumer Price Indices Technical Manual available from……

General

8 The Consumer Price Index is produced to the highest professional standards set out in the ……Code of Practice. It undergoes regular quality assurance reviews to ensure that it meets customer needs. The index is produced free from any political interference

Page 2

Note: For more information on quality reports (point 6 of the background notes to the illustrative statistical press notice) see Chapter 15.

CHAPTER 15

Organisation and Management

Introduction

15.1 Chapter 12 of the CPI manual covers organisation and management issues relating to price collection and the compilation and publication of the index together with performance management, development and training. This chapter of the handbook draws on the ILO manual but additionally gives more practical guidance including templates for the necessary documentation associated with a good organisation and management system. The ILO resolution does not specifically address organisation and management.

15.2 While this chapter is headed: Organisation and Management, the main focus is on management. It is difficult to prescribe any specific organisational structure for the CPI in isolation. The latter will be governed by the relevant public service requirement, which will be country specific, and by the overall organisational model adopted within the national statistics institute. In particular, it will depend on whether the national statistics institute is: structured along the lines of the statistical value-added chain (for example: sampling, data collection, coding and editing under separate management to compilation and analysis of outputs) to reap the benefits of specialisation; or by statistical output (for example, household budget survey, consumer price index) to reap the benefits of integrated team working; or by subject area (for example, national accounts, prices or economic statistics) to reap the benefits of subject area knowledge and expertise. Sometimes the CPI is grouped for management purposes with the producer price index in order to exploit synergies relating to index construction. In other instances, the CPI is grouped with national accounts because the two share a significant customer base and national accountants use CPI sub-series as deflators.

15.3 Frameworks for quality reporting and for improving CPIs are covered in detail in Chapter 18. Chapter 14 refers to two frameworks which provide mechanisms for enhancing dissemination standards, namely the International Monetary Fund's General Data Dissemination System (GDDS) and Special Data Dissemination Standard (SDDS).

15.4 The recommended structures and processes described in this chapter serve as best practice. For some national statistics institutes, resource and capacity constraints will sometimes mean that not all of the specific recommendations in this chapter can be followed. In these circumstances, national statistics institute should follow the principles underlying the recommendations, implement plans which address the key issues whilst reflecting local circumstances and aspire to the structures and processes described later in the chapter.

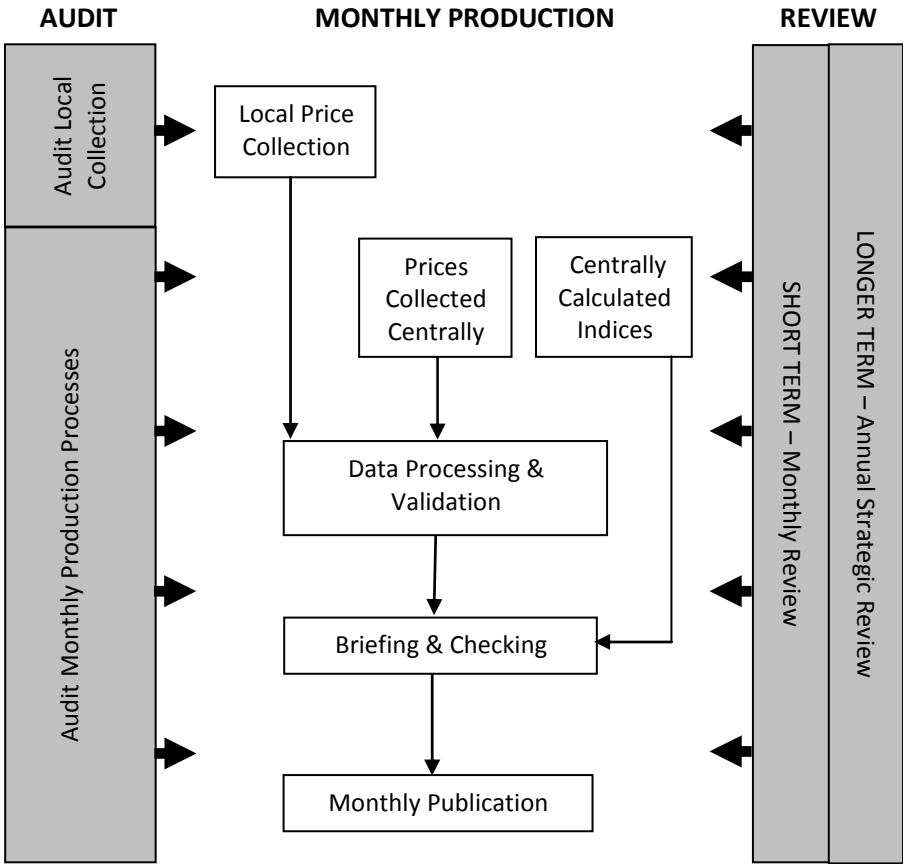
Overview of Quality Management System

15.5 A Quality Management System for the Consumer Price Index should be in place and should cover all aspects of CPI data collection and compilation including the audit of prices, validation of the production cycle itself and any annual review process which focuses on strategic and longer term issues. The latter is strongly encouraged because it is a major way of learning from past experiences and of identifying and taking forward actions which will improve the future quality of the CPI.

15.6 A conscious decision needs to be taken on whether to include in the main quality management system, periodic review processes such as chain linking and the updating of the CPI basket and technical development work such as the introduction of better sampling techniques and methods of quality adjustment for replacement goods. Such work should be managed using project management techniques, if not included in the main quality management system.

15.7 Figure 15.1 provides an overview of a prototype quality management system for the monthly collection of prices and compilation of the CPI. Each aspect should be seen as inter-dependent and an integral part of the whole. The precise outline of such a system will depend on the detailed arrangements and approach to price collection. For instance, the diagram allows for the possibility that some prices data is collected directly from the

Figure 15.1 Quality Management System



headquarters of large supermarkets or other chain stores (sometimes referred to as central shop prices) and that some price indices are calculated using price and sales information provided by a central authority, such as for energy prices or telecommunications, or are based on special methodologies requiring tailor-made index calculations such as for owner-occupier housing costs (sometimes referred, generically, as centrally calculated indices). Figure 15.1 will be referred to and considered in more detail later on in this chapter.

15.8 The key aspects of a quality management system for the ongoing production of CPIs, are threefold:

- The documentation of the monthly production processes from the collection of prices and through data processing to publication of the index.
- The auditing of local price collection and the monthly production process either internally within the national statistics institute or by an external auditor.
- A regular review system that focuses on both monthly production processes and longer-term issues.

Documentation

Overview

15.9 Good documentation is important as it can reduce the risk of errors from ambiguities and from misunderstandings and it can also identify aspects of methodology and compilation which warrant a review. There are four levels of documentation which underpin a quality management system. Figure 15.2 shows a typical structure for documentation relating to a CPI.

Level 1 - The Quality Manual

15.10 This document defines the Quality Policy and gives a general description of the system. It also describes the organisation of staff involved in producing the CPI, the division of responsibilities for the management of all aspects of the production cycle, and the general structure of the lower levels of documentation.

Level 2 - Procedures

15.11 These are a set of mandatory procedures, covering all aspects of the production cycle. They explain in broad detail the different parts of the monthly processing cycle and outline the responsibilities of the staff involved.

Level 3 - Work Instructions

15.12 The work instructions give full details on exactly how a task should be carried out.

Level 4- CPI Technical Manual

15.13 The CPI Technical Manual describes the procedures used to produce the Consumer Price Index and the price indices derived from it. It is aimed at users of the CPI who want to know how the data are collected and analysed and what formulae are used in the calculation together with other methodological detail.

Documentation control

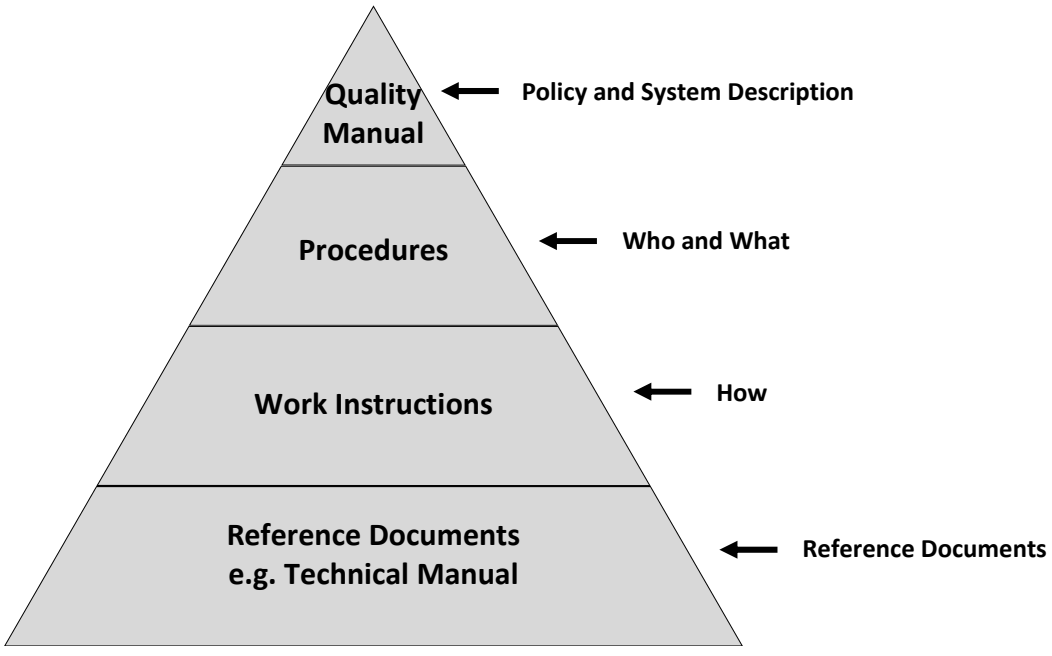
15.14 All documents in the Quality Management System should be subject to document control. The procedures on Documentation Control should explain how the document control works to ensure that all staff have access to the most up-to-date version when carrying out their work. In some NSI offices this is done by storing such documents as the Quality Manual, Procedures and Work Instructions electronically in a database managed by a document control custodian and using numbered versions to identify the latest copy.

15.15 An electronic system of documentation storage and control is recommended where the necessary technical infrastructure exists because it has four benefits over a manual system:

- **More efficient production** of documentation as it helps with initial compilation and reduces the need to print and circulate paper copies.
- **Better informed staff** because they have immediate electronic access to *latest* documentation including desk instructions with search facility by subject and author.
- **Better quality control** as authors, with the involvement of the document control custodian, can readily amend, date stamp and reference number updates and, just as importantly, access to non-authors is restricted to "read only".
- **Better search facility**, for example if staff are looking for cross references to a particular subject such as "chain-linking" or "weights".

15.16 Where a national statistics institute does not have the necessary IT infrastructure to operate an electronic system, it is still important that a document control custodian is appointed with the task and authority to keep a record and quality assure the most up-to-date paper documentation. The same principles of good documentation

Figure 15.2 Documentation



management apply whether the documents are stored electronically or are kept in paper folders.

15.17 A form for a document control template is given at Appendix 15.1.

Internal Audits

Overview

15.18 The auditing function is represented by the left-hand column of diagram 15.1. It is strongly advised that internal audits are carried out regularly according to a systematic timetable and that they are conducted by an internal audit team. Audits should cover all aspects of the monthly and annual processing cycle to ensure that the management systems are fully implemented and provide effective controls for Quality Assurance. The purpose of each audit should be to verify that operational procedures and controls comply with the documented procedures and determine their effectiveness in delivering a consumer price index which is fit for purpose. Thus an audit should aim not only to ensure that the index compilers adhere to the agreed procedures but that the procedures are improved where found lacking.

15.19 Audits should be conducted by personnel having appropriate training and experience to do so, ideally by people who are sufficiently detached from day-to-day operations to take an independent and objective view unhindered by close involvement in the production and compilation of the consumer price index. Too much familiarity can lead to unwarranted assumptions about the appropriateness of the procedures and the extent to which they are followed.

15.20 What follows is a description of the standard processes associated with performing an internal Audit and producing an Audit Report, with illustrative examples of the associated documentation.

15.21 To achieve external accreditation, such as ISO 9001(2000), additionally requires the organisation to undergo an external audit twice a year by the appropriate accreditation body. The advantages of obtaining external accreditation are that:

- It gives a discipline to reviewing and specifying production procedures and to properly documenting and quality controlling them.
- It can provide the efficiencies associated with a ready made standard for documentation and quality control and the added trust associated with a well-tested system.
- It minimises risks of errors by adding effective controls including a framework for the initiation, evaluation and implementation of change.
- It increases public confidence in the CPI, for instance as an index produced in accordance with internationally recognised standards.
- It provides a basis for more effective training of experienced staff and the induction of new staff.

15.22 Internal audits can provide the same level of objectivity and discipline where external accreditation is not an option and can be used on their own or in conjunction with external audits. It is recommended that internal audits are undertaken by people who are at arms length of the processes being audited. Other options include external audits carried out by CPI compilers from another statistical institute – in effect a form of peer group appraisal.

The role of an audit team and the responsibilities of its members

15.23 It is recommended that an "audit team" is assembled, which at a minimum consists of a Quality Manager and an internal auditor, each with a distinct, well-defined and complementary role. Where this is not possible because of resource constraints the two roles can be combined or the roles can be undertaken in conjunction with other responsibilities. In some statistical offices the role of auditing is undertaken by a methodology branch whose responsibilities extend beyond auditing to the development and introduction of better statistical techniques. Whatever arrangement is adopted, it is important that sufficient numbers of staff, qualified in auditing, are available in order to carry out these audit functions.

15.24 The Quality Manager should be responsible for:

- Producing an Audit Schedule, managing it and ensuring it is updated as necessary.
- Agreeing and specifying the objectives and scope of the audit.
- Managing implementation of the audits specified in the Schedule.
- Ensuring the auditor is properly trained.
- Ensuring that, where possible, the auditor is independent of the function being audited.
- Ensuring Review Reports are written.
- Ensuring audit action points are implemented.

15.25 The Quality Manager should prepare a schedule of audits covering all aspects of the CPI

production processes. This schedule should take account of:

- The importance and complexity of the different stages involved in the compilation of the CPI.
- The results and concerns arising from previous audits and any issues which have arisen since.
- The time since the previous audit.

15.26 An example of a pro-forma for an audit schedule is given in Appendix 15.2.

15.27 The Internal Auditor should be responsible for:

- Undertaking any necessary pre-audit investigation which will help determine the audit schedule and the focus and scope of investigation.
- Conducting the audit itself.
- Producing and circulating the audit reports.
- Updating documentation where necessary.
- Taking responsibility for monitoring and following-up actions from the audits themselves.

Objectives of an Audit

15.28 The objectives of an audit need to be clearly defined and agreed before it starts. The precise objectives will depend on local circumstances, but may be stated in general terms as follows:

- To assess compliance with documented procedures.
- To provide assurance to senior management that the agreed Quality Management System is being implemented, and is effective and relevant.
- To identify improvements required and any necessary corrective actions and preventive measures. This includes taking action to prevent problems occurring in future.
- To ensure activities are in accordance with the Quality Management System. This includes identifying whether there are any activities being undertaken which affect the quality of the index but which are not included in documented procedures.
- To ensure the procedures are adequate.

Auditing procedures and techniques

15.29 The success of an audit relies not only on clear objective setting and well trained auditors but also on the use of effective auditing procedures and techniques including a review of documentation and the carrying out of structured interviews with index compilers.

15.30 It is recommended that audits should incorporate the following procedures as standard:

Before the audit

- Review documentation for completeness and that is it up-to-date and indexed properly. Where applicable, check that updates are signed off correctly, and that minutes, action points and other documentation are correctly filed.
- Trace action points from previous audits and any reviews that have taken place, for example, compilation procedures.
- Prepare checklists to help facilitate the structured interviews.

During the audit

- Conduct structured interviews.
- Ask to be shown documentary evidence (spreadsheets, signatures on spreadsheets) to support staff responses to questions.
- Identify issues as they arise and advise the index compiler.

After the audit

- Produce a report, with recommendations
- Provide compilers with the opportunity to comment and then agree on an action plan.
- Try and resolve any disagreements and where appropriate include the index compilers comments in the report.
- Note opportunities for improvement to current procedures as well as non-compliance with them.

Audit report

15.31 It is recommended that similar issues identified in several areas are grouped under the same heading and documented as one audit observation. Clear and succinct headings should be used for each issue identified and a short description given of what was found. Observations can either be made in order of the most significant ones first or they can follow a logical sequence, generally the order in which the work activities underlying the compilation of the index are carried out.

15.32 For each audit observation, suitable remedial action should be recommended together with a statement of who is responsible for carrying out the

remedial action and the date when the action should be completed.

Risk assessment

15.33 In order to prioritise follow-up actions it is recommended practice to attribute an overall score to the risk associated with the issues arising from the audit. This can also be done individually for each issue identified and is a decision to be made by the NSI.

15.34 The results of an audit may be categorised as **Low Risk** if the issues which have been identified are unlikely to arise and if they did would result in major difficulties for the published CPI, such as errors in the published index. A **High Risk** categorisation will be justified if there is a significant chance that unless addressed the issue could lead to an error in the index, that is, the error will be of high impact and there is a significant chance of it happening. The results of all other audits should be deemed to be of **Medium Risk**.

15.35 If judged appropriate, the Quality Manager may issue an instruction for a follow-up audit. The proposed date for this audit should be added to the Schedule for Follow-up Audits and Progress Checks, and the actual date of the audit should be added to the schedule of internal audits. Whenever possible, the follow-up audit should be carried out by the same auditor who undertook the initial audit.

15.36 Appendix 15.3 gives an example of a template for an audit report and the recording of follow-up actions.

Review systems

15.37 This is represented by the right-hand side of diagram 15.1. A review system not only provides a check on current operational procedures but also helps to inform decisions on the introduction of longer-term improvements so that the Quality Management System continues to be up-to-date and relevant and to ensure that business risks are kept to the necessary minimum. It is for this reason that national statistics institutes are encouraged to put in place monitoring arrangements to track performance, supplemented by both short-term and longer-term review procedures.

Monitoring performance

15.38 Underlying what follows is the important principle that the effective management of the process of producing a CPI relies on an agreed set of objectives which where possible are supplemented by measurable targets.

15.39 Targets for the delivery of a CPI may cover both quality (data and statistical methodology) and timeliness and may encompass both the tracking of the data collection and compilation processes and the quality of the final output - the CPI. The national statistics institute will need to decide which are the most relevant for its CPI. Chapter 12 deals with data validation and Chapter 13 deals with measuring the quality of the CPI itself. Possible targets for monitoring monthly performance in terms of the process of compiling the CPI and maintaining its relevance, that is the intermediary steps in compiling a CPI and the subject of this chapter, may include:

- **Timeliness** - process delivery times meeting the agreed schedule. For example, whether the prices data was entered on to the computer and edited to the agreed timetable or whether index compilation took place on time so as not to potentially compromise publication.
- **Accuracy** – This might include the proportion of prices which are found to be wrong, the number of prices collected compared with target sample, errors in the compilation of elementary aggregates.
- **Delivery** – This might include the delivery of planned reviews of specific sub-indices and methodological reviews.

15.40 Clearly, an agreed monthly schedule of tasks associated with the compilation of the CPI is required in order to be able to measure performance as well as being required for the management of the processes.

15.41 Quality measures should be set for each stage of the compilation process. These measures, which should be as quantitative as possible, should be evaluated against pre-determined targets on an ongoing basis. Problems should be flagged during the production process allowing immediate corrective action to be taken if necessary.

Short-term monthly Reviews

15.42 It is good practice to hold a meeting of the CPI production team at the end of each month which focuses on quality and operational issues which have arisen during the course of the most recent production cycle. It would be wrong to be too prescriptive about the format of these meetings. The meetings can be fairly formal and involve a gathering of the whole team to exchange experiences and raise issues for resolution or more structured to include a general session where management presents a monthly performance report and where team members have the opportunity to react to or raise particular concerns. The format will reflect local

circumstances, including the size of the team producing the CPI and the management arrangements. Depending on the issues which arise it may be useful to follow up these meetings by smaller ad-hoc groups of staff brought together to tackle specific issues. Seminars and presentations may also be given.

15.43 Monthly reports on errors observed at data collection, data entry, editing, coding and data cleaning stages together with any compilation issues should be circulated to relevant members of staff with a view to taking action to minimize such errors in future.

15.44 The monthly review meeting should also include a forward look at issues arising over the next cycle so that appropriate working arrangements and solutions to other issues arising can be put in place. Thus the focus should be both on learning from past experience, for example to avoid problems repeating themselves, and on anticipating future issues for forward planning.

15.45 Action points should be recorded and individuals identified to follow them up.

15.46 The monthly review should also be used as a basis for a continuous improvement processes. As an example, field workers can be encouraged to analyse the root causes of pricing errors and develop individual development plans to correct these.

The use of fishbone diagrams

15.47 The fishbone diagram is an analytical tool that provides a systematic way of looking at effects and their causes. Because of the function of the fishbone diagram, it is often referred to as a cause-and-effect diagram.

15.48 A fishbone diagram can help the CPI team to:

- Identify the possible cause or reason for a specific problem.
- Analyse existing problems.
- Study all the possible reasons why a process is beginning to have difficulties, problems, or breakdowns.
- Study why a process is not performing properly or producing the desired results.

15.49 It is constructed using the following basic steps:

- Draw the basic fishbone diagram.
- List the problem or issue to be studied in the "head of the fish".
- Label each “bone" of the "fish".

15.50 The major categories typically utilised for price collection are Planning, Team, Respondents and Methodology, see figure 15.3.

15.51 Idea-generating techniques, such as brainstorming, are then used to identify the factors within each category that may be affecting the problem/issue and/or effect being studied. For example, the team should ask... "What are the Planning issues affecting/causing a high error percentage?"

15.52 This procedure is repeated for each factor under the category to produce sub-factors. The team then continues to ask, "Why is this happening?" and puts additional segments under each factor and subsequently under each sub-factor.

15.53 The process is continued until the team

Figure 15.3 Fishbone Diagram: an example

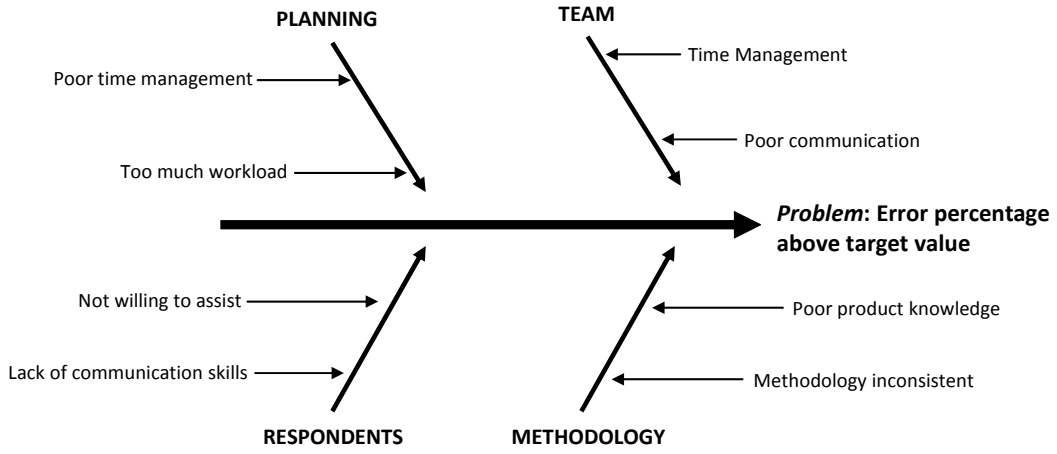


Table 15.1 Example of a table to formulate action plans

What do you want to achieve? List your goals	How will you implement the actions? List your methods	How will you know that the improvement goal has been achieved? List your measurement methods	(Who) Responsible person	(When) Start date	(When) End date

agrees that further iterations will no longer provide them with useful information.

15.54 The results are then analysed the results of the fishbone firstly by looking for those items that appear in more than one category. These become the 'most likely causes".

15.55 For those items identified as the "most likely causes", the team then agrees a listing in priority order, with the first item being the most probable" cause.

15.56 Specific action plans are then developed for the most likely causes to the problems to be addressed, using the what, when, who, where and how technique. Additional skills required and any development needs are also identified. See Table 15.1.

Long-term annual Reviews

15.57 The longer-term element of a quality review system takes a higher level strategic look at objectives and should be conducted through the annual planning cycle, where such a cycle exists, and should address both the quality of outputs assessed against user needs and the processes by which quality is achieved. Ideally, the latter should be laid down in an annual Quality Management Action Plan annexed to the main CPI work programme (see Chapter 18).

Training

15.58 The procedure of putting together documentation examined as part of a Quality Management System, together with feedback from the process of auditing, including the monthly and annual review processes, should help to identify training needs. These should be incorporated into personal development plans for individuals and in a higher-level Training Plan for the team responsible for the CPI. A template for a personal development plan is given at Appendix 15.4.

15.59 It is recommended practice to put in place pre- and post-training evaluation procedures to monitor the quality of training and its value against business needs and as an input into quality management. An example of a training evaluation form for providing feedback on specific courses is given at Appendix 15.5. It is important to clearly state the training objectives beforehand and ideally these should be agreed with the line manager.

15.60 Two particular aspects of training which are particularly relevant to the CPI are the training of price collectors and the training of those involved in using the prices data to compile a CPI.

Price collector training

15.61 One possible approach is to split the training into two phases:

- Shadowing – where all new price collectors accompany an experienced collector working on the CPI before they go through formal in-depth training. This, in part, is to test their aptitude for the job.
- Formal training – consisting of the following modules:
  - Desk training:
    - Introduction to the CPI: what is the CPI and why it is important. Why confidentiality is important.
      - The price collection schedule.
      - Dealing with the retailer, how to make initial contact and arrange visits, the carrying of identification badges.
      - Representative product selection.
      - The importance of item descriptions and how to choose replacement items.
      - Non-standard situations and prices, for example sales, missing goods, negotiating prices in markets.
  - Training in the field:

- First collection accompanied by a supervisor who will provide feedback on an appraisal form.
- Follow-up accompanied collection a few months afterwards.

15.62 It is recommended that collectors are accompanied routinely, once a year, say, to audit their performance and that where necessary refresher training should be given. The production of a brief practical guide to price collection, containing the key points that collectors need to know, is also recommended as this will provide price collectors with a useful reference document.

15.63 An annual conference of the field staff can be useful for training and developmental purposes, particularly when field staff have little face-to-face contact with Head Office or with one another.

15.64 Training of compilers – it is important that CPI production staff are not only trained in the handling of data on prices and in the production of the CPI, but also have a practical appreciation of price collection. They should have an overall understanding of how a CPI is compiled as well as a detailed understanding of their particular job. There are two advantages in this:

- Production staff will have a better appreciation about how their jobs fit into the work of their colleagues. This should enable them to add greater value to the work of the CPI team by, for example, making suggestions for improvements to the production processes.
- Production staff will be better able to cover for one another when individuals are on holiday or on sick leave.

15.65 Given the above, there is a strong argument for index compilers to be trained in price collection and, at the very least, to accompany a price collector or supervisor on a local price collection as part of their induction.

15.66 Non-technical training is also important. This could include supervisory and management skills (where appropriate), management of meetings, time management, how to deal with shopkeepers in a polite and considerate manner. For example, some national statistics institutes hold 'customer care' courses. Also the need should be assessed for IT training, especially for lower level staff,

15.67 In many NSIs it is the practice to issue checklists for the initial induction training to record the training undertaken.

Business continuity

15.68 The training of production staff in all aspects of index compilation and in the practicalities of price collection helps to reduce the business continuity risks due to staff absences etc but does not cover all eventualities. For instance, contingency arrangements need to be in place to cover: the failure of PCs or the mainframe computer; sickness amongst price collectors; the price collection company (where price collection is contracted out) going out of business; and the loss of price data as a result of forms or computer files being damaged or going missing. It is for these sorts of reasons that consideration should be given to having a disaster recovery plan.

Disaster Recovery Plan

15.69 The overall objective of the Disaster Recovery Plan (DRP) is to enable the national statistics institute, to continue producing the CPI to a standard which meets the requirements of users. There are two main dimensions to disaster recovery planning - price collection and index compilation.

Price collection

15.70 The overall objective of the DRP is to enable the NSI to carry out price collection with the minimum possible delay and quality deterioration. This might range from covering for price collectors who are on sick leave to headquarters staff taking over the price collection process at short notice from a contractor. The former can be covered either by another price collector or by headquarters staff who have been suitably trained (see above), whilst the latter situation would require a full-scale DRP. Elements of a full-scale DRP might include:

- Identifying DRP locations where prices would be collected by headquarters staff on a contingency basis to produce the "all items" CPI. The locations will need to be representative.
- A properly trained headquarters staff member allocated to each DRP location. Training would normally include familiarisation visits to the DRP location, say once a year. Alternatively, the strategy of some NSI is to use headquarters staff in rotation to collect prices each month in a location close to headquarters. They can then be assigned to price collection in other locations in the event of the need for cover due to a major problem occurring.
- Agreeing the methodology for linking in a reduced dataset to compute an index where a major catastrophe occurs and the sample needs to be reduced. This is likely to be on a matched

sample basis, in other words, for the reduced sample matching the prices for the same products in the same shops in the same locations and measuring the price change. Statistical simulations using previously collected prices data may help to inform the detailed final arrangements to be put in place

- Agreeing with customers, in particular the relevant Government ministries and the Central Bank the minimum requirements in terms of outputs. For example, publication schedules might be affected and the reduced data set may be inadequate for the computation of the usual sub-indices.

Index compilation

15.71 Problems with index compilation may range from covering for a member of staff who is absent from work because of a major disruption at the headquarters office to a major technical fault affecting PCs or the mainframe computer. Covering for an absent member of staff should be facilitated by good documentation and by giving all staff some basic training in all aspects of index compilation (see earlier sections) but can be further enhanced by a planned schedule of job shadowing. Major disruptions and failures require other action. For instance, some national statistics institutes pair up with another government ministry and come to an agreement to provide accommodation, desks and personal computers when an emergency situation arises, such as a major fire closing the head office of the NSI. Contingency arrangements against major failures with PCs or a mainframe computer or server include nightly back-ups being made on a different computer at a separate location. In addition, in the case of a mainframe, arrangements are often put in place to provide a standby computer facility at another location in the event of a disaster. Where such an arrangement is in place it should be tested to ensure that it works.

15.72 A reversion to the collection of prices on paper forms should be included as an option when major problems arise with electronic price collection and an assessment of the operational consequences needs to be included in a DRP.

Appendix 15.1: Documentation Control Template

DATE ISSUED	DOCUMENTATION	REF	DETAILS OF CHANGE	REASON FOR CHANGE	NAME OF ISSUER
XX/XX/XX	*Calculating CPI food item weights (non-seasonal)*	*2.1*	*Change in process with effect from...*	*CPI Technical Board has agreed that in the future weights should be taken from National Accounts.*	*Mr Smith, Consumer Price Statistician*
XX/XX/XX	*Calculating and updating price index for tele-communications services*	*2.5*	*Change in process with effect from...*	*Methodology changes in pricing structures for mobile telephones – new methodology agreed by CPI Technical Board. Reflects changing market*	*Mr Smith, Consumer Price Statistician*
XX/XX/XX	*Desk instructions for checking and editing of prices*	*3.1*	*Additional checks to be carried out based on month-on-month price change.*	*Last audit indicated current checks inadequate resulting in incorrect prices entering the CPI.*	*Ms Brown, CPI Operations Manager*

Appendix 15.2: Audit Schedule Template

		SCHEDULED AUDIT		LAST AUDIT				
PROCESS AND/ OR DOCUMENT TO BE AUDITED	**Ref**	**DATE AUDIT DUE**	**AUDIT ALLOCATED TO**	**LAST AUDITOR**	**DATE OF AUDIT**	**RISK ASSESSMENT (High, Medium or Low)**	**FOLLOW UP REQUIRED? (Y/N)**	**TARGET DATE**
Calculating CPI food item weights (non-seasonal)	*2.1*	*January*	*Mr Graham*	*Ms Jones*	*XX/XX/XX*	*HIGH*	*N*	*N/A*
Calculating and updating price index for telecommunications services.	*2.5*	*January*	*Mr Graham*	*Ms Jones*	*XX/XX/XX*	*MEDIUM*	*Y*	*April*
Desk instructions for checking and editing of prices.	*3.1*	*January*	*Mr Graham*	*Ms Jones*	*XX/XX/XX*	*LOW*	*Y*	*April*

Appendix 15.3: Audit Report Template

AUDIT REPORT – CONSUMER PRICE INDEX					
Audit No:	50	Date:	XX/XX/XX	Document Ref:	2.1
Process Audited:		*Calculating CPI food item weights (non-seasonal)*			
Owner:		*CPI Statistician (name)*			
OBSERVATIONS/FINDINGS					
1. *The CPI Technical Board has agreed that, in the future, weights should be taken from National Accounts – this will lead to various changes to the processes.*					
2. *The process document needs updating in order to reflect changes in methods*					
3. *It was agreed that the initial detailed instructions should be written at the same time as carrying out the process.*					
ACTION REQUIRED			DUE:	TAKEN:	
1. *Changes made to the process documentation to reflect new methods.*			*XX/XX/XX*	*XX/XX/XX*	
2. *Follow-up Audit*			*XX/XX/XX*	*XX/XX/XX*	
RECCOMMENDATIONS FOR FUTURE QUALITY IMPROVEMENTS					
1.					
2.					
3.					
AUDITOR:	*Mr Graham*		AUDIT DATE:	*XX/XX/XX*	
FOLLOW UP AUDIT – DETAILS OF ACTION TAKEN					
1.					
2.					
3.					
AUDITOR:			AUDIT DATE:		

Appendix 15.4: Personal Development Plan

Name: *Ms Jones*	
Start Date: *XX/XX/XX*	**End Date:** *XX/XX/XX*
Grade: *Principal Statistician*	**Line Manager:** *Mr Graham*
Organisational Unit: *Consumer Prices*	**Post Held:** *Statistician*

INSTRUCTIONS

Competency: Areas of competence where you have identified that some development is needed in order to enable you to reach your full potential in your current position, or prepare you for promotion.

Development Need: Why you feel that it is necessary for you to develop the specified competency.

Method of Learning: How you will develop the identified competency i.e. e-learning, internal or external training, shadowing?

Position Holder Evaluation: Consider what knowledge and skills you have gained from the development and what impact they have had on your outputs and the outputs of your team.

Line Manager Evaluation: Consider what has been the impact of the new knowledge and skills on the outputs of the job holder and the team.

PERSONAL DEVELOPMENT PLAN

	Competency	Development Need	Method of Learning	Position Holder Evaluation	Line Manager Evaluation
1	*Managing data*	*Need to develop improvements to the monthly validation checks on CPI data – Microsoft Excel.*	*Microsoft Excel - external training*	*The course enabled me to learn new methods for validating data and the formula and functions needed in Excel to carry out this task. I have since introduced 2 additional validation checks to the monthly process.*	*The job holder has implemented two valuable validation checks which improve the quality of CPI data.*
2	*Knowledge about sources*	*Need to understand price collection processes and how they feed into data delivered for CPI compilation.*	*Shadowing price collector in 2 locations*	*I found the shadowing of price collectors useful to understand the particular challenges in price data collection. This has enabled me to better understand the data used for compilation of the CPI.*	*The job holder now has a better/complete understanding of the price collection process enabling them to carry out their current role effectively and also to be available to cover price collection as part of the disaster recovery plan.*

Appendix 15.5: Training Evaluation Form

Name of Trainee:	
Learning Activity:	
Date of Activity:	

1. What were your training objectives

i.
ii.
iii.

2. Were the objectives of the course met?

Yes	No	Partially

3. Which elements of the course did you find particularly useful? Please list below and provide a short explanation.

4. Which elements of the course, if any, did you find least useful? Please list below and provide a short explanation.

5. Did you learn new skills and knowledge from the course?

Yes	No

6. Was the content of the course relevant to your role?

Yes	No

7. Will you be able to apply the learning when you return to the workplace?

Yes	No

8. Do you need additional support or training?

Yes	No

9. Please rate the materials used throughout the classroom based sessions

	Excellent	Good	Fair	Poor
Power point				
Hand-outs				
Case studies				
Others				

CHAPTER 16

User Consultation

Introduction

16.1 Understanding users' needs is essential in ensuring the relevance of the consumer price index and its proper use. It is therefore important that mechanisms are in place to obtain users' views on a regular basis both to facilitate effective stakeholder engagement in the planning process, for instance in identifying priority areas for methodological improvement or the development of additional indices, and to provide users with advice on the strengths and weaknesses of using different indices for different purposes. User consultation is particularly important in connection with the CPI given the fact that there is a particularly broad and disparate body of users and there are many different uses of the index.

16.2 Paragraph 82 of the 2003 ILO Resolution on CPIs states the responsibilities that NSIs have to consult users, and Chapter 13 of the CPI Manual has a short section at the end on user consultation, including the role of Advisory Committees.

16.3 Neither the ILO Resolution nor the Manual addresses the more general but equally important issue of stakeholder engagement and management and the need to develop appropriate mechanisms to manage the diverse range of customers and complex relationships. This is considered at the end of this chapter after considering the specific issue of user consultation.

The general principles of consultation

16.4 Engaging users should be an integral part of the statistical process. When the CPI work programme is under review and developments in CPI outputs and methodologies are being contemplated, consideration should always be given to whether there are issues on which users need to be informed or consulted. Where there are such issues, allowance for consultation needs to be built into the future work plan, including the resource requirements and a time allowance for the period of consultation.

16.5 Three principles underlie effective consultation:

- Clarity over who is being consulted, about what issues and for what purpose.
- Simplicity in presentation of the issues, in particular well structured documentation which effectively summarises the key points.

1. Transparency in the process, including records being kept of all the documentation including user views and subsequent discussions and actions plus a record of the decision and the arguments supporting it.

16.6 It is important that consultation arrangements relating to the CPI are put in the public domain in order to protect the integrity of the index and the processes associated with its development and production. Consultation with users and complete openness in the mechanisms used to consult will help maintain confidence in the CPI.

16.7 User consultation on the CPI may be part of a more general consultation process relating to setting priorities for the overall statistical work programme of the NSI - covering all outputs and the submission of bids to the finance ministry for resources - or may be specific to the CPI. The latter may be necessitated by its special status. It forms a major part of this chapter and is addressed in more detail below after a brief discussion on the practicalities of conducting a general user consultation process as part of the planning process.

User consultation for planning future work programmes and submitting budget bids

16.8 Producers of official statistics have an obligation to produce a statistical programme that takes into account the needs of users and the available resources and reflects priorities. This necessitates a process of user consultation which should cover all official statistics, especially in respect of a statistic as important as the CPI. Consultation arrangements will depend in part on

the degree of centralisation of the statistical system and, more particularly, on the governance arrangements operating locally. Consultation may be undertaken for three purposes:

- At a high level, as part of good governance arrangements and achieving value for money in the delivery of user needs, normally in the context of the statistical programme as a whole. For example, where this is a responsibility of the chief national statistician, or where there is a Statistics Board with a statutory obligation to consult users as part of a planning and reporting function to Parliament. It is assumed that the CPI would be a part of any such general arrangements.
- Bidding for resources for a future work programme as part of the planning process. This will need to be timed to fit into the formal planning round as directed by the finance ministry. Consultation should exploit mechanisms for engaging customers such as, on-going user groups (for instance a CPI User Group), one-to-one consultations with key users such as the finance ministry or central bank, especially convened user forums and other regular meetings with users. General consultation via inserts in statistical journals and on the NSI website can also be effective and may have the advantage of reaching more customers. Consultation on the make-up of a future work programme may include a general indication of what the NSI considers to be the priorities.
- Allocating funds between different elements of a work programme once the overall budget has been determined. This may be in the form of a formal consultation on a draft statistical work programme flowing from (2). A clear indication should be given of the extent to which there is flexibility to amend the draft programme.

16.9 The risk of consulting and not being able to accommodate all users, needs to be balanced against the risk of not consulting and suffering reputation damage. On the latter, it is also important to manage user expectations by presenting a clear and robust message on the need for realism and that difficult choices may need to be made, when set against the fact that budgets are not unlimited. It is also important to explain to users the basis of decisions. This will be helped if there is a transparent process for the allocation of funds. The latter should be supported by a set of criteria for determining priorities. For instance, whether the central theme is to improve current outputs or to produce more or whether the priority is to produce more regional data, say, or to increase coherence between different statistics.

Special arrangements for consultation on the CPI

16.10 The CPI is one of the most widely used and high profile statistics produced by a statistical office. It is used for a multitude of purposes and its scope and definition, together with the detailed methodologies applied, can have far reaching consequences for the management of the economy, for government expenditure and for the living standards of individual citizens. Such circumstances warrant special consultation arrangements in addition to those in place for government statistics more generally and which have been described above.

16.11 There is a particular obligation on CPI producers to consult users on any changes which may impinge on the scope and definition of the CPI and give due regard to the views expressed and to the legal basis of the CPI. In contrast, decisions on issues relating to detailed methodology fall within the remit of the statistician as long as the agreed scope and definition are not compromised. However, the statistician may wish to seek advice from independent experts on the relative merits of different methodologies, for example via a technical expert group, and may publish the conclusions of the group before coming to a decision, to facilitate wider user engagement and maintain user confidence in the technical quality of the index.

Who to consult and on what

16.12 Issues which require special consultation arrangements partly depend on local circumstances, for example, the existence of well defined protocols on user consultation derived from uses of the CPI and general governance arrangements which are enshrined in law – such as for the indexation of state benefits. In some countries there is a requirement for the national statistician to consult and seek agreement from parliament or the government on changes to the CPI where proposals might potentially conflict with the intentions of parliament with respect to legislation relating to the indexation of state pensions and benefits.

16.13 Parliament and the government will need to be consulted as major users, as appropriate and in line with the protocols of the individual countries concerned. In this context it is important to have a clear understanding of the basis of the consultation and the following distinctions can be helpful.

- *Scope.* This refers to the breadth and coverage of the CPI in terms of population and expenditure. For example, whether the expenditure of visitors from abroad should be included.
- *Definition.* This establishes what the CPI should measure. Essentially it prescribes the conceptual basis. For example, whether it is a cost-of-living index or a measure of pure price inflation.
- *Methodology.* This refers to the statistical techniques used to collect data and construct the CPI in the best way which is compatible with its scope and definition. The focus of methodology is on implementation.

16.14 Decisions on methodology, as defined above, are the responsibility of the national statistician. It is also the responsibility of the national statistician to offer advice and make recommendations on the scope and definition of the index regardless of the decision making processes. The latter are conceptual issues determined by the use of the index[58]. But the obligation on Government and its relationship with Parliament arising from the use of the CPI for the indexation of state benefits and pensions, and, for example, tax allowances, imposes a particular obligation on the National Statistician to consult and, in some instances, defer the decision to government or parliament. Transparency of processes is particularly important in this situation, especially the publication of the advice offered by the national statistician.

16.15 A flow diagram illustrating such an approach is given at Appendix 16.1. It is, of course, just one of a number of possible models. Flow diagrams can be useful in articulating the decision making process and in providing greater transparency.

Practical options for consultation-advisory committees

16.16 Clearly there are many possible variations to the model shown at Appendix 16.1 and practices can vary significantly between different statistical offices. Issues to be decided include:

- *Whether the CPI advisory committee should be a standing committee*, that is, one which meets regularly and is not time-limited and which looks at the continuous development of the CPI and has scope to decide on which issues warrant consideration and to initiate work. The alternative is an ad hoc committee which is only convened when a particular issue arises on which advice is required. The arguments are finely balanced and depend, to some extent, on the governance arrangements relating to the CPI and other official statistics. In particular, the arguments will be influenced by whether there is a formal committee structure in place for statistical assessment of the NSI's outputs and for putting together future work plans and the extent to which a standing CPI advisory committee fits into this structure.
- *Whether the remit extends to scope and definition* or is restricted to methodological issues. For instance, whether the committee should pronounce on whether the current scope is the appropriate one for fitness of purpose when taking into account the uses of the index.
- *Who convenes an advisory committee and decides on membership and who should it report to*. If the committee's remit is restricted to methodological issues then it should be the national statistician, although the latter should consider undertaking consultation before decisions are made, for instance on membership, if this increases the acceptability of the committee in the eyes of users. It is less clear cut where authority lies if the remit extends to scope and definition. As indicated earlier the national statistician may defer decisions on scope and definition to the government or parliament (see also the section on the role of the statistical office and the national statistician).
- *The make-up of the committee*. In particular, whether it should be restricted to price index experts from academia and NSIs or should include the main users. The answer to this depends on whether the view is taken that the advisory committee is essentially a group of experts whose function is to look at detailed methodological issues or whether it has a broader remit to investigate issues relating to scope and definition. If the latter, a common practice is to appoint a broad-based committee and nominate a technical sub-committee to give advice on the more technical issues which arise.
- The inclusion of non-government users and experts helps to reinforce the "independence" of the committee, and the inclusion of non-technical experts, such as employers and trade union representatives, provides not only a helpful user perspective but also helps users to

[58] Paragraphs 1 to 7 of the 2003 ILO Resolution on CPIs introduce the different definitions of a CPI associated with different conceptual bases for different purposes. A discussion on how the scope of the CPI is dependent on the uses for which it is intended is given in paragraphs 8 to 14 of the Resolution.

understand the practical constraints of index production and the inevitable compromises that sometimes need to be made. It can add to the perceived integrity of the index.

- *Who decides on whether to accept the recommendation, or should the conclusions be binding*? The answer to this depends to a large extent on the answers to the first three bullet points listed above. But professional and methodological issues should be under the remit of the national statistician.

Advisory committees - operational arrangements and terms of reference

16.17 It is important that a CPI advisory committee is furnished with sufficient resources to enable it to do its job satisfactorily and that it is seen to be independent. Clear terms of reference should be drawn up which address the issues raised in the previous section. Arrangements should be transparent and the publication of background papers and discussion, as well as the terms of reference and final recommendations, should be the norm. Permission should be sought before evidence submitted to the advisory committee is published. This is best done by exception - that is making a general announcement that the presumption will be that any evidence submitted to the committee can be made publicly available.

16.18 It is strongly advised that a date is given for the delivery of any reports which are commissioned.

16.19 An example of a model terms of reference is given at Appendix 16.2.

16.20 It is also important that advisory committee reports are properly structured with a clear statement of the issue, an evaluation of the options and the arguments supporting the final recommendation. A possible structure for an advisory committee report is given at Appendix 16.3 although the precise make-up will depend on the terms of reference. Advisory committee reports should be published.

Advisory committees - role of the National Statistics Institute and the National Statistician

16.21 User consultation is an integral part of the role of an NSI in fulfilling its responsibilities for maintaining and improving the quality and relevance of official statistics and the public's confidence in them. The requirement of the NSI and the National Statistician to fulfil these commitments would argue for, all things being equal, the National Statistician convening an advisory committee and determining its terms of reference and for the advisory committee to report its findings to the National Statistician.

16.22 Correspondingly, operational arrangements would normally lie with the NSI which would provide a chairperson and a secretariat. The national statistician should consider chairing an advisory board if the issues under consideration are particularly important or sensitive.

Stakeholder engagement and management

16.23 Users are a sub-set of the community of stakeholders in the sense that every member of the community has an interest in good quality official statistics even if they do not use them. For example, a reliable CPI is essential for effective economic management - an unreliable index can lead to bad policy decisions and an eventual drop in the standard of living of each citizen.

16.24 Carefully nurtured relationships, based upon regular and open dialogue, will not only assist forward work planning and the management of user expectations but also will help to reinforce the legitimacy of the CPI and to raise the profile and influence of the NSI and increase trust in and support for it. Stakeholder management implies a more proactive relationship than stakeholder engagement and is more appropriate for managing relationships with influential stakeholders who have a major interest in the CPI. Most will be major users such as the relevant government departments, which determine economic policy, and the national bank which has operational responsibilities relating to the running of the economy, for example for setting interest rates.

16.25 Common components of a stakeholder management strategy include:

- Identifying the different types or groups of stakeholders.
- Determining the objectives for the relationship with each group.
- Developing processes for delivery and feedback.

16.26 A possible taxonomy for the identification of stakeholder is given in figure 16.1 and can be used as the basis for a stakeholder engagement and management strategy. The extent to which this

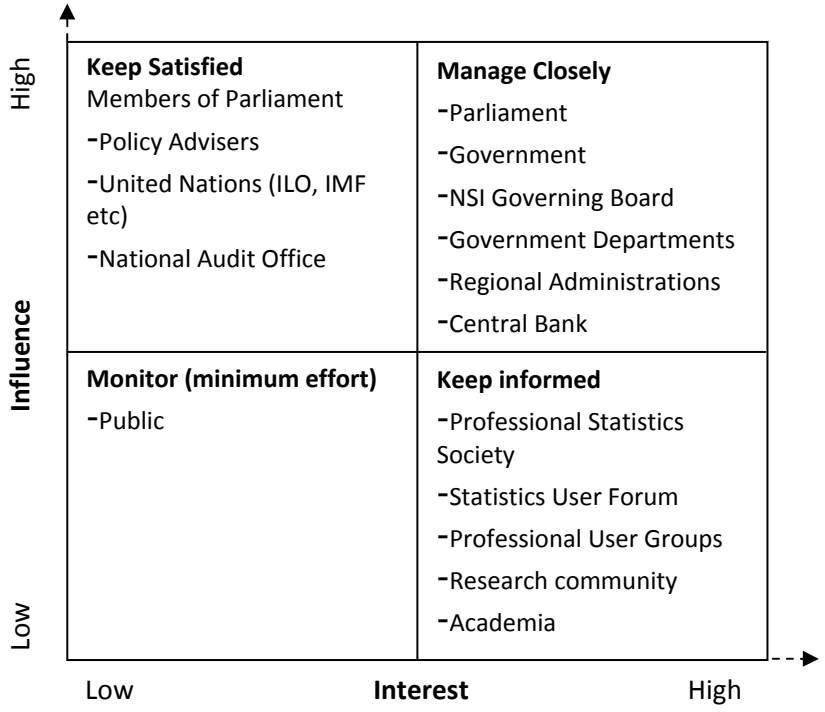
particular taxonomy is appropriate for a particular country depends on individual circumstances. For each category a clear understanding needs to be arrived at on why stakeholders - who may also be users - need to be engaged. For example, this may be for information sharing, building partnerships (for instance where a body provides expenditure or prices data), obtaining empowerment and influence (particularly with influential stakeholders) or consultation. If the latter then it may be more appropriate to include the stakeholder in the more formal processes of user consultation already described above.

16.27 Possible mechanisms for stakeholder engagement and management include:

- A system of "key accounts". This is where a senior member of the national statistics institute - or "key account" holder - is given the task of managing external bilateral relationships with key stakeholders, that is, with those stakeholders who are influential and have a major interest in official statistics, more often than not because they have a heavy dependency on them. Candidates for "key accounts" may include government departments with responsibility for managing the economy, the finance ministry and the national bank. Key accounts usually cover all the statistical interests of the key account holder and would not normally be restricted to one particular output from the national statistics institute. Thus a "key account" would not normally be set up to manage the interests of a particular organisation solely in the CPI.
- Thematic Working Groups. These would normally be led by the national statistics institute and they work on the philosophy that there are distinct and heterogeneous groups with an interest in particular themes such as "the economy". The thematic working groups can provide a proactive forum for bringing users, producers and other interested parties together for information sharing and to discuss how the official statistics produced by the NSI can better meet user requirements for particular generic themes. Thematic Working Groups can be used as a user consultation or planning mechanism or both. Their success depends not just on the appropriate grouping of themes and choice of membership but also on effective governance and reporting arrangements being in place.

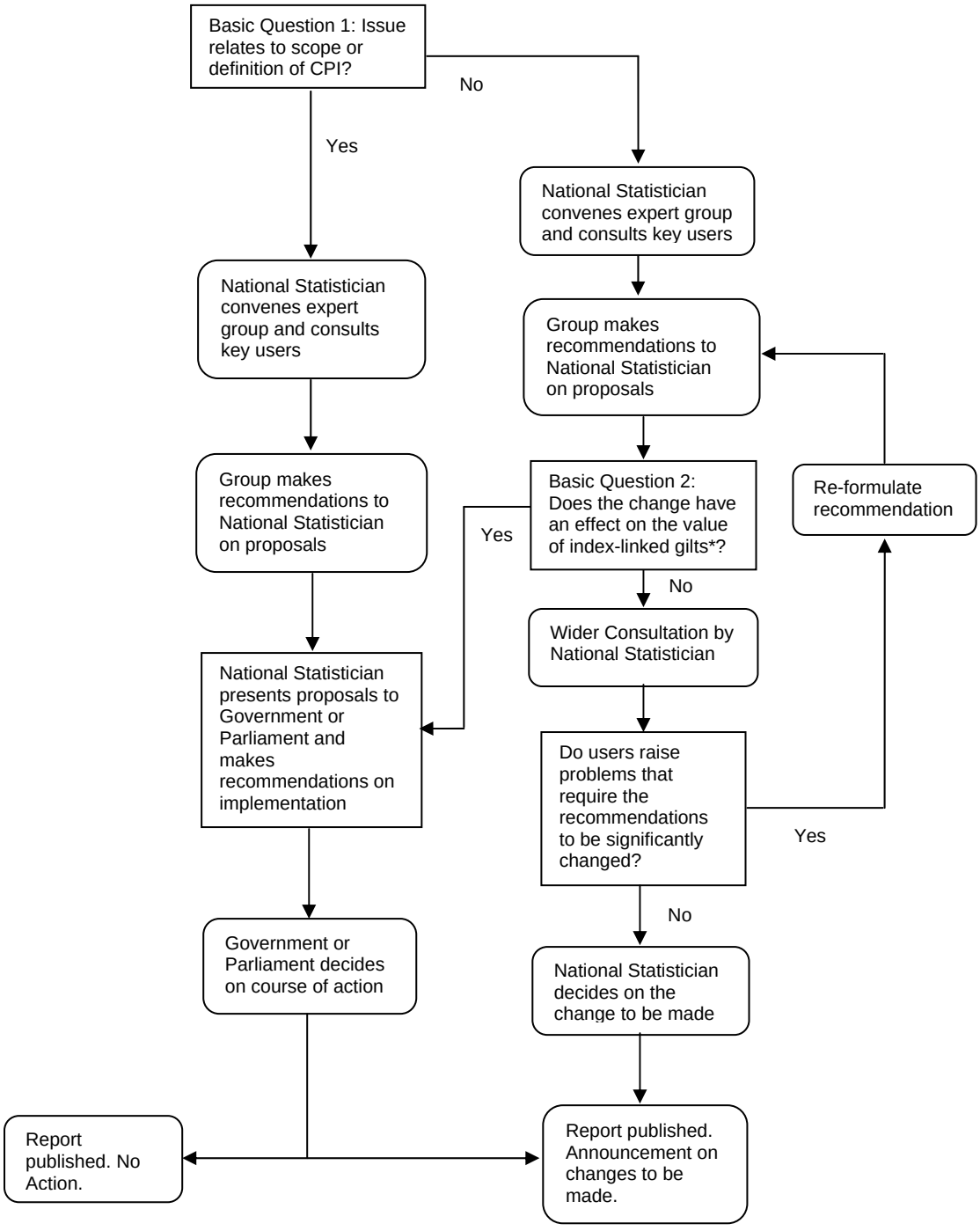
16.28 Less informal mechanisms may be more appropriate for managing less influential stakeholders with less of a major interest in the CPI. This could include a facility on the national statistics institute official website for members of the public to log issues, advertisements in the newspapers requesting feedback and postal or face-to-face surveys of the general public.

Figure 16.1 Stakeholder Engagement and Management Matrix



Appendix 16.1 Decision Making

Note: In basic question 2, gilts refer to Government index linked securities.



*or overrules the intentions of parliament on the indexation of state benefits

Appendix 16.2 Example of terms of reference for a CPI Advisory Committee

In this example the CPI Advisory Committee is a standing committee and scope and definition are deemed to lie outside its remit. There is no "general" as opposed to "expert" user representation, the former being part of a process of user consultation, the latter as part of a process of drawing on user experience. The terms of reference may be as follows:

"To advise the National Statistician and make recommendations on issues submitted to it by the National Statistician which relate to the methodological development of official consumer price indices produced by the Government Statistical Service taking into account considerations relating to the accepted scope and definition of the indices produced."

In this context, the following definitions apply:

1. *Scope* refers to breadth and coverage in terms of population and expenditure.
2. *Definition* establishes what an index should measure. Essentially it prescribes the conceptual basis, for example, whether it should be a cost-of-living index or a pure price index.
3. *Methodology* refers to statistical techniques used to collect data and construct the index in the best way that is compatible with its scope and definition. Thus the focus of methodology is on implementation.

The Committee will report to the National Statistician.

In framing its recommendations the Committee will take into account best international practices and the current ILO Resolution on Consumer Price Indices.

The Consumer Price Indices Advisory Committee (CPIAC) will also support the National Statistician in fulfilling the latter's obligation to produce a high level statistical programme that reflects the needs of users. The CPIAC will do this by:

1. Reviewing progress made on the introduction of methodological developments including on the implementation of earlier Committee recommendations that have been accepted by the National Statistician.
2. Quality assuring, prior to implementation, methodological developments relating to routine index maintenance, such as the changes that form part of a periodic exercise conducted to ensure that the consumer prices 'shopping basket' – the selection of items priced each month to measure inflation – is up to date and representative of consumer spending patterns and that the approach to price measurement remains relevant.
3. Providing an input into future research agendas with a view to maintaining the relevance of published price indices and in particular drawing the national statistician's attention to any concerns it has about the methodology used in index construction.

It will meet as directed by the National Statistician and at least annually to fulfil its quality assurance role with respect to the annual updating of the consumer prices "shopping basket". It will submit an annual report within three months of the end of the financial year to which it relates. Background papers, minutes of meetings and recommendations submitted to the National Statistician will be published to coincide with the release of the corresponding annual report.

In general the views of the Committee will be expressed through its annual report and the minutes, but the Committee can produce and publish papers of its own on the topics it is asked to investigate by the National Statistician. It may also publish individual reports and recommendations on specific topics passed to it for consideration.

Membership of the Committee will consist of experts, including expert users, and will normally consist of no more than eight people and at least six. Members will be chosen for their expertise and will not have a representational role. Membership will depend on the topics under discussion but the core membership will consist of expert producers and users. In addition there will be three academic statisticians/economists, who will be chosen according to the skills relevant for the topics under discussion.

The Committee will be serviced by a small secretariat from within the National Statistics Institute.

These arrangements are designed to deliver statistical integrity and consumer price indices that are accessible and fit for purpose.

Appendix 16.3 Example of a possible structure for an advisory committee report

1. TERMS OF REFERENCE
2. Membership
    a. Names, job titles, affiliations and dates of appointment
3. Introduction and summary of findings
4. The issue(s)
    a. User requirements
    b. International guidelines
    c. Methodological options
    d. Experience of other national statistics institutes
5. Recommendations with argument
6. Appendices
    a. Background to current methodology
        i. History
        ii. Reasoning
    b. International guidelines and practices (additional detail)
    c. Technical details of proposed methodological recommendation(s)
    d. More detail of options rejected by the committee
    e. List of people who submitted evidence together with evidence submitted
    f. Estimated numerical impact of recommendation on index

CHAPTER 17

CPI/ICP Integration and Harmonisation

Introduction

17.1 This chapter goes beyond the CPI itself to a close relative: the International Comparison Programme (ICP). Many countries – in fact the majority – participate in the ICP: 146 were included in the 2005 round. The aim of the ICP is to make international comparisons of economic aggregates such as Gross Domestic Product (GDP) per person, using specially calculated exchange rates known as Purchasing Power Parities (PPPs). PPPs eliminate the effects of different price levels and consumption patterns across countries. They result in more meaningful comparisons than if ordinary exchange rates are used.

17.2 Appendix 4 of the CPI Manual addresses the topic of integrating CPI work with the International Comparison Programme (ICP). Section 5 of the Appendix, in particular, lists the benefits of CPI/ICP integration including reduced costs and the prospect of better methodologies leading to better data and improved statistical estimates, particularly of purchasing power parities. Section 5 also discusses two core strategies for CPI/ICP integration: the use of a price-determining characteristics approach to determine what to price rather than pricing very specific and narrowly defined items in each country and the linking approach, which unlike the price-determining characteristics approach does not require all countries to use the same product characteristics classification.

17.3 The characteristics approach makes greater use of national CPI prices data but requires a price to be attributed to each price-determining characteristic. Even with a standard product characteristics classification, these can be difficult to compute, particularly for complex goods, such as computers, which have a number of price-determining characteristics whose values are inter-dependent. For example, it can be difficult to compute individual values for processor speed and for size of memory in a PC, where new models may include increases in both. Techniques such as hedonics can be used, but they require large data sources and considerable statistical expertise.

17.4 The second core strategy – the linking approach - is more appropriate for many developing countries. Pairs of countries are identified for bilateral comparisons. The pairs of countries can then be used for multilateral comparisons by using chains constructed on the basis of the bilateral links. Again this approach should, at least in principle, make better use of CPI data as countries are paired according to the degree of similarity in their retail markets. But neither method is fully developed. Further exploratory work is needed before either strategy can be followed.

17.5 There are major benefits available to individual countries that participate in the ICP. Participation can provide the catalyst for improvements to the national price statistics programme, household budget surveys (HBS), national accounts, government finance statistics, and to more general aspects of statistical infrastructure. For these reasons the ICP is regarded as an important catalyst for sustainable and long-term national statistical capacity-building. This chapter does not discuss the ICP as such, but describes ways in which national CPIs can benefit from ICP participation, and, to some extent, the value of well-constructed CPIs to the ICP. The two systems can in fact be of mutual benefit.

Spatial versus temporal price indices

17.6 A CPI is a temporal price index; it measures price changes within a country or region, over time. There is a base period, such as a particular month or year, which is set to 100. Price levels in subsequent periods are expressed as index numbers relating to the base of 100. So an index of 110 indicates a price rise of 10% compared with the base period. The geographic coverage of the index is the same for each index observation.

17.7 The ICP is a spatial index. It can be compared with a CPI in which geographical locations are substituted for time periods. Thus, a “base country” can be selected and its average price level set to 100. Comparable price levels in other countries are calculated, and differences in average prices are converted to index numbers relating to the base

country. For example, the USA may be the base, with an index set to 100, while for the same time period Morocco has an index of 55. This indicates that average prices in Morocco at the time of the comparisons are 45% below that of the USA.

17.8 There are other important differences between temporal and spatial price comparisons. With CPIs there is a natural sequence of comparison, namely the months and the years in order of date. CPIs are set out in a time series, usually starting with the earliest period and ending with the latest. This is the basis of inflation calculations. They can be used for comparing any two points of time but the reliability is dependent on how 'distant' the time periods are. Comparisons that are decades apart are less accurate than month to month comparisons. This is because consumption patterns in widely separated periods will be very different because of product innovation and other changes that affect incomes and tastes. They will be less accurate even if considerable care is taken to ensure regular re-basing and adjustment for quality changes.

17.9 With spatial comparisons, the ordering is less obvious. However, a concept of 'distance' also applies to spatial indices. 'Distance' is not defined in geographic terms but rather in terms of the similarity of consumption patterns. Comparisons involving similar countries will be more reliable than those involving very dissimilar countries. This is one of the reasons why the ICP is conducted in regions using their own product lists rather than attempting to use a single global product list. However, it must be borne in mind that although any two countries can be compared, the accuracy of the comparison becomes increasingly unreliable as the 'distance' between the two countries increases.

17.10 A major practical difference between a CPI and an ICP comparison is that the products selected for a national CPI should all be representative products within the country. From a sampling perspective, there is no point including in a CPI products which are rarely consumed. Moreover, each collection period must aim to measure the prices of the same products, i.e. to make "like-with-like" comparisons. But for international comparisons it is not possible to make "like-with-like" comparisons across all products and countries, since different countries have significantly different consumption patterns and, in consequence, different representative products. Rice may be a staple diet in one country and potatoes in another. Much of the work of the ICP is directed at problems such as these and finding workable compromises.

17.11 Another difference between the CPI and the ICP is their scope. The CPI is restricted to household consumption expenditure but the ICP uses the national accounting framework and covers the much broader concept of gross domestic product.

Basic data relationships between the ICP and CPIs

17.12 Despite the important conceptual differences between CPIs and the ICP referred to above, in practice many of the basic data requirements are very similar for the two systems. Although the expenditure scope of the ICP is broader than that of the CPI, they have two closely related common data sets, namely the prices of products representative of the consumption patterns of households and the expenditure weights that reflect the relative importance in household budgets of those products.

17.13 In the CPI, prices are collected from different outlets located throughout the country. The selection of the outlets and the areas from which prices are collected is based on multi-stage sampling designs. The expenditure weights are usually derived from a Household Budget Survey (HBS). The goods and services are classified using a standard system such as the Classification of Individual Consumption according to Purpose (COICOP) or a similar national classification. The lowest level of product classification at which expenditure weights are available is used in identifying the elementary aggregate indices. Higher groupings lead finally to total household expenditure. Period-to-period changes are calculated by comparing prices for identical products. Occasionally this is not possible because product specifications change. Adjustments are then made for the change in the quality or specifications of the product.

17.14 In the ICP it is necessary to first identify the products to be priced by participating countries. Ideally the selected products would be available, exactly as specified, in each of the countries participating in the comparison. In practice this is never the case. The resulting problems are less severe when fairly similar countries are being compared but where comparisons involve dissimilar countries the problems are more acute. A problem arises if there are major differences in the consumption baskets at the detailed level. For example, two countries may have similar weights for COICOP 01.1.1 (bread and cereals) but at a detailed level the weights for, say, cassava and millet flours may be very different. In one country cassava flour may be representative but in the other it may be millet that is representative. Another problem arises from differences in the quality of products. The ICP requires that, for a given specification, all countries

price the same product. Often countries are unable to do this and the item priced may deviate in a small way from the specification. Where the difference relates to the units or quantities of measurement the quality adjustment is relatively straightforward as long as the required meta-data are correctly recorded. For more subjective quality differences judgments are needed in order to adjust the price observations. The ICP quality adjustment task (to assess the value of the difference in specifications) is essentially the same task as is needed for CPI quality adjustment.

17.15 The ICP process starts with establishing a product list for each ICP region and sub-region using Structured Product Descriptions (SPDs) (see references later on). Countries propose products for inclusion in their respective region's list. For a given region many products are likely to be similar, but others may be quite different. The ICP methodology requires the preparation of a common list of products which is representative of the countries in the region. The aim is to maximize the overall representativity of the common list. Countries then select a subset of the regional list which they agree to price. In selecting the subset, countries aim to maximize the representativity of the national list. The country lists are then reviewed to ensure there are sufficient products being priced in each basic heading[59] by each country, to produce reliable data. Where necessary countries may be asked to add some less representative products to ensure there are sufficient matches across countries[60].

17.16 Seen from the point of view of the participating country, at the end of the process there will be an ICP product list which contains (a) as many as possible of the products which are representative in the country concerned and (b) a number of products which may be found and priced in the country, even though they are not representative. The country will also have omitted some additional products that were on the regional list because they were not able to be priced. The omitted set of products should be as small as possible relative to (a) and (b). How such a composition may be achieved in practice, and how this can help to integrate the two systems is discussed later.

17.17 Once the prices data are compiled, the next stage in the compilation of a CPI is the aggregation of the detailed price changes to higher levels. To do this, it is necessary to have consumption weights, usually drawn from HBS data. In many cases, detailed expenditure data may not be available for all the regions within a country. For ICP purposes, the HBS data must be able to provide reliable estimates of national average weights, rather than, say, weights representative of consumption in urban areas. For many products the consumption weights (after adjustment for scope differences as mentioned below) will be the same for the ICP and CPI. But there are some important differences. The ICP definitions must follow national accounts definitions. Major differences can be found in.

- The treatment of own-account consumption (e.g. households growing and consuming their own food). This is usually excluded from CPIs but must be included in the ICP.
- The treatment of owner-occupied housing. The ICP uses imputed rents, whereas CPIs use a variety of methods, sometimes even excluding owner-occupied housing entirely.

Integration of CPI and ICP datasets

17.18 The CPI is a vital tool for the management of an economy, and as such it is usually given a high profile and may be relatively well-resourced. At the very least, it can be generally assumed that a national CPI will remain a permanent part of a statistical office's work programme. On the other hand, earlier ICP rounds have been conducted at infrequent and irregular intervals. Consequently, the mechanism and the resources needed for effective ICP participation have had to be re-started for each new round. This gives rise to organizational problems as generally the expertise gained from earlier ICP work is lost by the time of the next round.

17.19 Because of the value of the ICP data, and to maximise the organisational benefits for countries, there are advantages in establishing an ongoing ICP programme with phased data collection similar to the OECD and European PPP programmes. With this background, it would clearly be an advantage if the ICP is linked as closely as possible to the regular CPI system. This can be done by maximizing the quantity of data usable in both systems. In this way, ICP participation can become less of a burden for participating countries, and the quality of both ICP and CPI data can improve. In addition, there are many potential benefits for the CPI and other parts of a statistical office's work, especially national accounts and the HBS. The ICP can be used to improve measures of poverty and income inequality, and to allow meaningful comparisons of economic data with other countries within and between world

[59] A basic heading is the smallest aggregate for which expenditure data are available.

[60] http://siteresources.worldbank.org/ICPINT/Resources/Ch5_Product_Lists_Apr06.doc

regions. The potential benefits of integration are discussed below.

Integration benefits from ICP participation

17.20 First, it should be borne in mind that a benefit for the ICP can be a benefit also for NSIs. The ICP and CPI have overlapping products. To the extent that the two data collection operations are integrated and duplication is avoided, staff will be at least partially relieved of the extra workload.

17.21 It has been a long-standing requirement of ICP participation that countries should be able to show post-hoc examples of benefits which the ICP has brought to the CPI and other aspects of their national statistical systems. However, in previous rounds of the ICP this aspect was to a large extent ignored, probably due to the overriding needs for the provision of data for the ICP itself and the lack of funds for the necessary follow-up work. The 2005 round of the ICP enabled some follow-up work to be done.

17.22 What aspects of a CPI can benefit from the experience of ICP participation? The answer to this question will depend to some extent on national circumstances and in particular on the state of development of the CPI itself. A list of areas of potential improvements is given below, and is discussed in the following paragraphs.

- More efficient use of classifications.
- Improved quality of weights.
- Wider geographic coverage.
- Improved outlet coverage.
- Improved outlet selection.
- Aligned CPI/ICP product lists.
- Improved product specifications.
- Better quality adjustment.
- More efficient price collection.
- More efficient data processing.
- Improved documentation.
- Better staff training.
- Reduced costs.

More efficient use of classifications

17.23 The ICP product list is based on COICOP, the international classification designed to classify individual consumption expenditure according to purpose. International standards recommend the use of this classification in the national accounts, HBSs, in establishing CPI weights, and in other areas.

17.24 Some countries that have not yet adopted COICOP for their national CPI and other statistics have found that the ICP provides the incentive for making the change. In any case, the System of National Accounts (SNA 2008), which most countries have implemented, requires adoption of this classification. This can be done much more easily if it is applied consistently across the national statistical system; for CPI weights, for HBS data, for ICP, for national accounts and for government finance statistics.

Improved quality of weights

17.25 The ICP demands high quality weights, in respect of both freshness of data and accuracy. The ICP Operational Manual has the following remark concerning the up-to-dateness of weights: "If the [most recent HBS] is more than 10 years old, you will need to make it up-to-date by adjustments to survey data reflecting changes in demography . . . . . or expenditure patterns". The ILO Resolution on CPI states that "weights should be reviewed and if appropriate revised as often as accurate and reliable data are available for this to be done, but at least once every five years."

17.26 Although the cost of conducting an HBS is high, having reasonably up-to-date results is more likely to give accurate weights than making ad hoc adjustments based on incomplete information about changing patterns of expenditure. Countries should also bear in mind that with a Laspeyres-type CPI they can reduce upward bias to the CPI if the weights are updated more frequently. This is because the results of substitution to lower-priced products are more quickly reflected in the CPI.

Wider geographic coverage

17.27 The ICP and the CPI have different needs for geographic coverage. The ICP attempts to measure national average price levels at a particular point in time, whereas the CPI measures price trends over time. If time trends in different parts of a country are fairly similar, a limited geographic coverage, if correctly designed, can provide a fair estimate of national price trends in the CPI. But price levels may differ according to region and between urban and rural locations. Furthermore, these relationships may differ across commodity groups[61]. During times of major structural change, significant changes in

[61] For example domestic fresh produce may be cheaper in rural areas than in the cities but imported goods are likely to be cheaper in port cities than in distant regions or in rural areas.

regional and urban/rural price differentials can also result. The ICP thus demands coverage which reflects the average level of prices in the entire country. In some countries this implies extending the geographic coverage of price collection. At the same time, some countries are concerned that their CPI coverage fails to reflect national trends, in particular regarding differences in trends between urban and rural locations. Furthermore, some countries produce, or would like to produce, regional CPIs, and for this reason a wide geographical coverage is needed. Such countries can benefit from ICP participation as it shows how regional coverage can be extended, thus enabling a permanent extension of coverage for the CPI.

Improved outlet coverage

17.28 There are similar arguments here to those regarding geographic coverage discussed above. If time trends across different outlets are fairly similar, limited outlet coverage can provide a fair estimate of national price trends in the CPI. However, this condition is unlikely to hold during times of significant structural change The ICP measures national average prices, thus requiring coverage of all main types of outlet. ICP experience can be used to review CPI outlet-types. The results of such reviews often indicate that an extension of outlet types for the CPI is desirable and achievable. For example, it may happen that supermarkets are less well covered than market stalls, which could upwardly bias the CPI if the increasing market share of supermarket sales is not correctly reflected.

Improved outlet selection

17.29 ICP methods can stimulate countries into re-thinking how to select individual outlets for sampling, to enable the appropriate coverage of ICP products. To the extent that ICP products are partially incorporated in the CPI, the same outlets can be added to the CPI sample. For example, comparison of the ICP product list with the CPI product list may have led to the conclusion that DVD players, say, are sufficiently widespread to warrant inclusion in the CPI. But if the outlets which sell DVD players are not well covered in the CPI, there may be a need to extend the coverage so as to include more of them. The same outlets can be used for ICP and CPI price collection.

Aligned product lists

17.30 Product list alignment is potentially one of the most important areas to benefit from ICP-CPI integration. It opens up the prospect of updating the CPI list to make it more relevant to present day purchasing habits. It also allows the overlap between the CPI and ICP lists to be maximised, thereby reducing the burden of extra price collection on NSIs in future ICP surveys.

17.31 Increasing product list alignment can be achieved in several ways. Firstly, most countries have products in their CPI list that have not been reviewed for a long time. By reviewing both lists, old products in the CPI list can be replaced by more relevant products from the ICP list. Secondly, it may be found that the CPI list is unnecessarily long: close comparison with the ICP list may suggest possible redundant products. Thirdly, a review of the products in the ICP list, especially relatively new products such as mobile telephones some years back, may alert CPI statisticians to the need to add such products to their list. Fourthly, it may be found that the specifications of a product may differ only slightly between the two lists. As the ICP specification is often more precise than the CPI specification, the latter can be replaced by the former - provided of course that the ICP product is representative of national consumption.

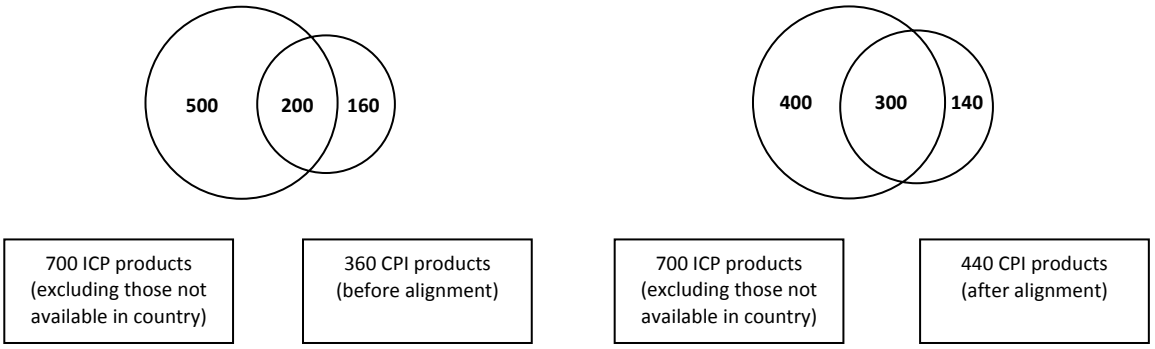
17.32 Adjustments along all of the four lines described above will automatically lead to an increased overlap between the CPI and ICP product lists. Experience shows that the degree of overlap of the CPI and ICP lists can be increased by 25% or more. Such an increase considerably eases the burden of work for subsequent ICP rounds without jeopardising the quality of the CPI – in fact CPI quality can be improved as a result of having more up-to-date and detailed product specifications. The outcome of such a review is illustrated in Figure 17.1, which uses actual data from a country that participated in the 2005 ICP round.

17.33 From the figure it can be seen that in the 2005 ICP round it was necessary for this country to price 500 products over and above the 360 already priced for the CPI – a "burden ratio" of 1.4 (500/360). For the next ICP round (assuming no changes to the ICP list) it would be necessary for only an additional 400 products, out of a total of 440 in the CPI, to be priced – a burden ratio of only 0.9 (400/440). It may be noted that part of the increase in the overlap rate is related to an increase in the size of the CPI product list. But in this case the ICP work coincided with a planned review of the CPI basket, which was in need of renovation and extension.

Improved product specifications

17.34 The 2005 round of the ICP used a structured approach to product specification. The "Structured Product Description" (SPD) was introduced to help ensure that the products priced across countries

Figure 17.1 Effect of improved CPI/ICP alignment



within a region were comparable. An SPD is a generic description which lists the price-determining characteristics relevant to a particular narrow cluster of products. Such characteristics include: specific product characteristics; quantities and packaging types; seasonal availability etc. They have generally been welcomed by ICP participant countries because they impose a valuable framework and discipline across the entire range of products to be priced in the ICP and help provide clarity as to what is required. The SPD, which is determined at a regional level, is used to create product specifications which define a specific product for price collection purposes.

17.35 Most countries already have well-functioning and efficient CPI price collection forms. But in some countries the forms used may not include all the product and outlet information necessary for consistent and reliable price collection. Some countries have found that the ICP SPDs provide a useful basis for designing a more efficient form. For example, the SPD includes boxes for describing the origin of the product, the type of packaging, the acceptable weight range and so on. Even if the layout of the SPD is not suitable for CPI collectors, many of its ideas can be carried over into the national CPI collection form. Some countries rely too much on the unwritten knowledge of experienced collectors, which can result in a gradual loss of accuracy of the precise product descriptions required.

Use of quality adjustment

17.36 Explicit methods of making adjustments to the prices of products that have been selected to replace discontinued items are often not made in national CPIs. In recent years, the use of such methods has been seen to be crucial to the accuracy of CPIs – see Chapter 7. In the ICP, quality adjustment is also vital. International comparisons of identical products are the essence of ICP work. When a country is unable to price a product on the ICP list, it should find, if possible, a close substitute and adjust its price based on an assessment of the value of the difference in quality between the target product and the product actually priced. The methods used for making such quality adjustments can be used also in the CPI, and the experience gained by ICP work can be invaluable for subsequent CPI work.

More efficient price collection

17.37 An ICP Operational Manual for Price Collectors[62] was developed for the 2005 ICP round. It provides practical advice on the price collection process. Most of the guidance given can be applied with little change to the CPI price collection process and help to improve its efficiency.

17.38 Some important aspects covered by the Operational Manual include:

- The need to become familiar with the price collection sheets (using photos of products).
- The collection timetable.
- The use of timesheets.
- Familiarity with outlets, their proprietors, and details such as opening hours.
- The need for careful route planning and transport arrangements where necessary.
- Instructions on completing the price collection sheet.
- Notes on the number of price quotations required.

[62] See http://siteresources.worldbank.org/ICPINT/Resources/ICP_Price_collectors_manual_4Nov.DOC

- Instructions on what to do when outlets are closed or products are unavailable.

More efficient data processing

17.39 Integrated ICP-CPI software for future processing of both ICP and CPI data, including modules for data input, verification and editing, calculation, and output can enhance data quality. But the practical problems of development, deployment and maintenance of computer programmes and the resources required should not be under-estimated.

Improved documentation

17.40 The 2005 ICP round achieved major advances in planning and management. Among its successes were a new set of manuals covering the ICP work at all levels from the theoretical to detailed organizational issues. While these were written for the purposes of the ICP, national CPI practitioners at all levels have found much of the material of benefit to their work on the CPI. For example, the ICP Operational Manual includes sections written especially for local price collectors, including such detail as the advance planning for the daily route, tasks to do at the start and end of the day, and a list of the items needed to be taken by the collector for the day's work. The ICP manuals provide a useful model for countries wishing to develop improved internal CPI documentation.

Better staff training

17.41 As a consequence of their 2005 ICP experience, some countries have extended their CPI coverage in terms of regions, products and outlets. To support these extensions they have strengthened the staffing of the prices division and introduced a permanent regime of staff training for head office and regional staff, including price collectors. Training sessions used materials developed for the 2005 ICP round and built on the training given to staff working on the ICP.

Cost Reduction for both ICP and CPI data collection operations

17.42 Costs can be cut by integrating the two data collections. Savings can be made in areas such as the use of staff and equipment, using a shared outlet sampling frame, training, data editing and validation. Shared outlets offer savings in terms of transport, time and taking advantage of the benefits of good contacts with outlets. As savings are achieved, statistical offices are encouraged to further integrate CPI/ICP work into other areas of statistical activity.

CHAPTER 18

Quality Reporting and Improving the CPI: Frameworks, Checklists and Work Programmes

Introduction

18.1 Paragraphs 81 to 85 of the 2003 ILO Resolution make reference to the need to respect both the "UN Fundamental Principles of Official Statistics" and the "ILO Guidelines concerning dissemination practices for labour statistics". Both address issues of integrity, engagement with users and the principles underlying production and dissemination. The UN principles are given at Appendix 18.1. The ILO guidelines, which were endorsed at the Sixteenth International Conference of Labour Statisticians, 1998, can be accessed on the ILO website www.ilo.org. The guidelines cover four headings relating to:

- Access to data, metadata and statistical products (access).
- The terms and conditions under which statistics are produced and released (integrity).
- Publication issues including timing, information on coverage, reference periods, and the main aggregates to be released (data).
- Regularly updated documentation providing metadata on definitions, methodology, sources, sampling error and other quality indicators, plus advance warning of revisions and estimates of the impact of discontinuities (quality).

18.2 The primary focus of the guidelines is labour market statistics but they are also relevant to Consumer Price Indices.

18.3 This chapter of the Handbook provides guidance on reporting mechanisms which provide the metadata which are necessary to fulfil the above obligations of producers of CPIs. In particular, it looks at the use of quality frameworks and checklists. Two such examples of the former are the International Monetary Fund's General Data Dissemination System (GDDS) and Special Data Dissemination Standards (SDDS). Other examples include the OECD Quality Framework and Guidelines for OECD Statistical Activities and Eurostat's Quality Framework for European Statistics. There is also the IMF Data Quality Assessment Framework. This provides a flexible structure for the qualitative assessment of a CPI which can be used in a variety of contexts, including self-assessments performed by national statistical offices, central banks, and other data producing agencies.

18.4 The focus of this chapter is on the use of these and similar frameworks to provide users with the metadata that they are entitled to on the characteristics, quality, access and integrity of the CPI and, correspondingly, the information that an NSI needs to know and collect to monitor whether it is fulfilling its international obligations and meeting the needs of users and to enable it to put in place a programme of improvements. A framework can be augmented by a checklist of compulsory and/or desirable characteristics of a CPI. The use of a checklist can also be used as an input into a metadata framework. They should be seen as complementary.

A model framework: quality reports

18.5 Using one of the internationally recognised frameworks for reporting on the CPI is recommended because it has a number of advantages:

- It has the authority associated with an internationally agreed framework and benefits from the experience of different countries.
- It allows comparisons on a like-for-like basis with CPIs produced by other countries.
- It is readily available.
- It fulfils the reporting obligations to international organisations.
- It provides the basis for reporting to users.

- It provides a benchmark for future developments, particularly when carried out in conjunction with a checklist.

18.6 Such frameworks are generic in nature and not specific to CPIs, apart from the Eurostat quality reporting framework for the European Harmonised Index of Consumer Prices (HICP). The latter is based on the IMF's Special Data Dissemination Standards (SDDS) specifically adapted for the HICP. Appendix 18.2 gives an example of a model "quality" report document based on the reporting framework for the HICP. Quality is defined as "fitness for use" in terms of user needs and extends beyond the statistical accuracy of the index to its definition and coverage, effective dissemination and the transparency of the statistical system. See Appendix 1 of the CPI Manual for further information on the EU HICP.

18.7 The general principles underlying the publication of "quality" reports on the CPI, as with all official statistics, are that:

- The reports should be easy to access and use by all interested parties.
- The contents should be sufficiently detailed to allow users to assess fitness for particular purposes. Qualitative (and where possible quantitative) measures of quality should be included to help users to understand better the strengths and the limitations of the CPI and associated series and the corresponding implications for interpretation and appropriate use.
- Quality measures and detailed technical information should be supplemented by guidance on interpretation to help users assess fitness for purpose.
- Clear statements should be given on the degree of compliance with agreed definitions, methods and practice - including both those determined nationally and those laid down in the 2003 ILO Resolution on CPIs - and any known reasons for deviations.
- Where possible, the presentation of information on quality will be tailored to meet the needs of different types of users, with more comprehensive information being prepared for expert users. This may indicate separate quality reports directed at different user groups.
- Producers should systematically review at regular intervals the documentation relating to the CPI and update it to reflect up-to-date methods and processes.

18.8 In order to provide a benchmark for future developments, it is important that where standard definitions, methodologies and procedures are not followed, a development plan should be included in the report or as a supplementary document. This should include the procedures to be followed to achieve compliance. Thus, these frameworks provide both guidance to the user on the appropriate uses of the CPI and benchmark information to producers for the formulation of a work programme for CPI maintenance and development.

A model framework: checklists

18.9 For internal purposes a checklist might also be useful, which would generally be more specific than a document design for public dissemination and would constitute part of a more detailed evaluation and corresponding development programme for operational use. Appendix 18.3 gives an example of a model checklist based on compliance with the 2003 ILO Resolution on CPIs. Similar checklists could be used for compliance with national standards or aspirations and with plans to develop internationally harmonised consumer price indices.

Planning: work programmes

18.10 Quality reports and checklists should be fully integrated into the planning mechanisms for a corresponding CPI statistical work programme. The latter is an essential part of the process for the continued development of a CPI and for fulfilling the delivery function of the NSI. It is, itself, part of an over-arching system of programming, planning and reporting.

18.11 The general principles underlying a programming, planning and reporting system are that:

- There should be clear and transparent governance arrangements relating to:
  - The allocation of responsibilities for monitoring and reporting on the production and dissemination of the CPI and on its development.
  - The setting of protocols relating to the scope and definition of the CPI and the methodological detail which supports the latter.
  - Putting in place and managing the day-to-day operational arrangements.

- The operational arrangements should be consistent with the governance arrangements and should:
  - Incorporate an effective process for consulting with users.
  - Provide a mechanism for regularly reporting, say annually, to users and other relevant parties on the answers to three questions:
    - What has been done to maintain the integrity of the CPI over the past year?
    - What are the outstanding shortcomings and issues?
    - What does the NSI intend to do during the next year to address these questions?

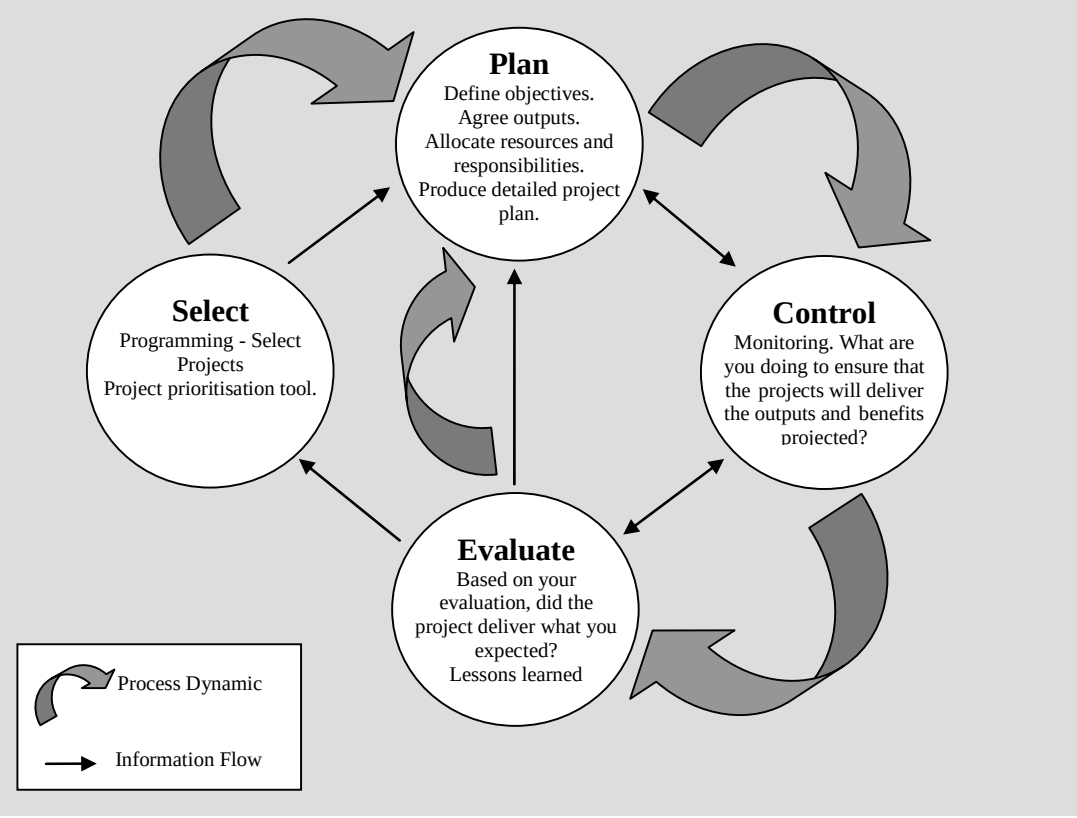
18.12 Given the importance of the CPI it is the practice in many NSIs to incorporate the answers to the three questions listed above in their annual report, usually alongside the corresponding information for other major statistical outputs. This has a number of advantages, most particularly:

- User convenience. Most users of the CPI will also be users of other economic statistics and it is helpful to them to have this information for a number of statistical outputs in one comprehensive report.
- It is the least resource intensive and generally the most effective way of reaching the target audience.
- It is transparent.
- It may also fulfil any statutory requirements relating to external reporting, for example the need to lay an annual report before Parliament and the requirement that "statistical work-programmes are published, and periodic reports describe progress made" (Principle 1 of the European Statistics Code of Practice).

18.13 Further advice on mechanisms for consultation with users is given in Chapter 16. In some instances this may include the use of a CPI Advisory Group and/or a CPI User Forum.

18.14 The UN Handbook of Statistical Organisation provides some useful guidance on planning, budgeting (including accountability) and reporting. The Handbook focuses on the characteristics associated with a successful statistical agency and addresses the statistical system as a whole but much of the advice which is given can be applied to specific

Figure 18.1 Programming, Planning and Reporting process



statistical outputs such as the CPI. A number of principles are presented in the UN Handbook.

18.15 A plan should:

- Outline the objectives and outputs.
- State a timescale.
- List the steps to be taken to deliver these.
- Allocate a budget.
- Identify who has responsibility for delivery (accountability).

18.16 There should also be an effective control system to monitor progress and take corrective action as necessary, in compliance with best practice project management principles. An evaluation should be undertaken to determine whether objectives and outputs have been delivered within budget and preferably should be undertaken by a different person from the one who has responsibility for delivery. The latter adds to the credibility of the system but may be difficult with the CPI where the number of experts within the office may be limited. Evaluation also provides an opportunity to learn from experience.

18.17 An overview of the types of arrangements for an over-arching system of programming, planning and reporting is illustrated in Figure 18.1.

18.18 One of the objectives of the programming, planning and reporting process is to ensure the efficient use of resources. For this it is essential to know the value and the cost of the CPI and to have tools for evaluating projects to determine priority actions for improving outputs. This is addressed in the following section.

Frameworks for valuing and costing the CPI as a statistical output and determining priorities for methodological and other developments

18.19 A number of NSIs have developed formal "project prioritisation tools" and planning templates to assist with forward planning in connection with the further development of key statistical outputs such as the CPI. Essential elements of a project prioritisation tool, by which priorities can be established within a CPI programme, and more generally across statistical programmes within an NSI, include:

- An assessment of customer demand.
- Legal, regulatory or contractual obligations.
- An assessment of the impact on the quality and relevance of the CPI.
- Financial cost and staffing requirements.
- The potential for the project to generate savings in the longer-term.
- The capacity of the office to successfully undertake the project, i.e. whether the relevant statistical expertise is available to deliver the project outcome.
- The extent to which the project builds future statistical capacity.
- How the project fits in with the overall strategy for the development of CPIs (and for the NSI as a whole).

18.20 Such tools often incorporate a "scoring scheme" to identify the relative cost-effectiveness of different competing pieces of work in contributing to the business aims of the NSI. An illustrative example is given at Appendix 18.4. In this example, the percentage total "score" column is a weighted average of the values attached to a number of attributes and provides a broad indication of the relative merits of a particular piece of work relating to the CPI. The spreadsheet also re-weights the attributes to provide a measure of "effectiveness" and a "traffic lights" indicator is displayed in the "Effectiveness" column: red for "not effective"; amber for "effective to some extent"; green for "highly effective" based on the total "score" obtained. The score for "efficiency" is calculated in the same way but with a value for "savings" in place of the overall "weighted value". In other words, it is calculated by the difference between "savings" and "net cost" without any assessment of the wider benefits of the project to the CPI, the user or the national statistics institute (NSI). The effectiveness and efficiency indicators should be considered in conjunction to give a complete picture of costs versus benefits.

18.21 Such a tool is, of course, mechanistic and reliant on the "values" placed upon the different attributes. The latter are a matter of judgement by the national statistics institute, as are the definitions of effectiveness and efficiency. Because of the mechanistic and judgemental nature of the tool it should be used to help inform decisions rather than as the sole basis for determining work priorities. A "comments" column is helpful to put the "score" in context by providing other useful background.

18.22 Such tools are normally written in spreadsheets to allow for ease of calculation and for

undertaking a series of iterations. They can be used for informing judgement both on undertaking new CPI projects and on ceasing to produce some outputs. The first example in the table in Appendix 18.4 represents a new project requiring finance. An activity which is a potential candidate for dropping is given in the second illustrative example. The third illustrative example shows a project which is both effective and efficient.

Project Management

18.23 Efforts to introduce changes to price indices, particularly major innovations, come with associated risks. These risks need to be managed to ensure that the benefits and objectives are achieved within budget, within the agreed timetable and to the required level of quality and that no problems arise with the regular production of the CPI. It is advisable that major innovations are managed as a 'project' and that project management methods are used to provide a framework for running, controlling, and guiding the project to a successful conclusion. There are various internationally recognised project management frameworks, for example, Projects in Controlled Environments (PRINCE2) which is used extensively in the UK government sector. Such frameworks provide management tools for various aspects of project management, including:

- Creating a business case/project mandate
- Initiating a project, defining scope, defining quality and identifying dependencies
- Tools for effectively planning the project and controlling the plan throughout the life of the project
- Organisation and governance structures, i.e. the use and make-up of a project board and the role of the project manager.
- Tools for managing issues and risks
- Methods for reporting during the project's life
- Project documentation used at each stage in the project

18.24 The management of risk is particularly important in the context of a high-profile and important statistic such as the CPI. Appendix 18.5 focuses specifically on the management of risk, which is a key element of project management.

Appendix 18.1 Fundamental Principles of Official Statistics, Endorsed by the United Nations Statistical Commission, 1994

Principle 1. Official statistics provide an indispensable element in the information system of a society, serving the government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlements to public information.

Principle 2. To retain trust in official statistics, the statistical agencies need to decide according to strictly professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of statistical data.

Principle 3. To facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics.

Principle 4. The statistical agencies are entitled to comment on erroneous interpretation and misuse of statistics.

Principle 5. Data for statistical purposes may be drawn from all types of sources, be they statistical surveys or administrative records. Statistical agencies are to choose the sources with regard to quality, timeliness, costs and the burden on respondents.

Principle 6. Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.

Principle 7. The laws, regulations and measures under which the statistical systems operate are to be made public.

Principle 8. Co-ordination among statistical agencies within countries is essential to achieve consistency in the statistical system.

Principle 9. The use by statistical agencies in each country of statistical concepts, classifications and methods promotes the consistency and efficiency of statistical systems at all official levels.

Principle 10. Bilateral and multilateral co-operation in statistics contributes to the improvement of systems of official statistics in all countries.

The UN Fundamental Principles of Official Statistics with more details and explanations are available online on www.unstats.un.org/unsd/default.htm.

Appendix 18.2 Model Quality Report Document for the CPI

	SUB-HEADINGS: SPECIFIC TOPICS FOR INCLUSION	ILLUSTRATIVE RANGE OF ISSUES WHICH MIGHT BE COVERED
DATA	Coverage	▪ *Population (e.g. treatment of institutional households, rich/poor households)* ▪ *Basket of goods and services (any exclusions e.g. owner-occupied housing, informal markets)* ▪ *Expenditure (e.g. final household monetary consumption, treatment of foreign visitors, expenditure of resident population abroad, own-account production)*
	Periodicity	*Weekly (all or some prices only)* *Monthly (all or some prices only)* *Quarterly (all or some prices only)* *Point in time or spread over month*
	Timeliness	*Time-lag between price collection and index publication*
ACCESS	Public access	*Pre-announcement of publication date.* *Simultaneous release to all.*
	Dissemination format	*Electronic/paper.*
	Pre-release access	*Protocols on any pre-release arrangements.*
INTEGRITY	Transparency	*Protocols on compilation and dissemination of CPI are published and readily accessible.* *Protocols comply with UN Fundamental Principles.*
	Revisions	*Statement of revisions policy, revisions clearly marked.* *Advance notice given of methodological changes, numerical impact given.*
QUALITY	Publication of information needed by users to asses quality	*Dissemination of documentation on methodology.* *Confidence intervals calculated and disseminated with other information on quality/accuracy of CPI.*

Appendix 18.3 Model Checklist based on compliance with the 2003 ILO Resolution on Consumer Price Indices

		Y	N	*COMPLIANCE STATEMENT (with supporting evidence)*	*ACTION PLAN where appropriate (including deliverables and timetable)*
1. USES	a. Alternative price indices available for specific purposes (if extra expense justified).				
	b. Alternative price indices appropriately defined and named.				
	c. Where only one index, definition determined by main use.				
2. SCOPE	a. Target population relevant to use				
	b. Population excluded is explicitly stated				
	c. If geographical scope is restricted due to resources, this is explicitly stated. d. Resident or domestic consumption.				
	e. Index covers all types of consumer goods and services relevant to the reference population.				
	f. No omission of illegal or socially undesirable goods or services.				
	g. Goods and services purchased for business purposes or expenditures on assets excluded from the index				
3. BASKET / WEIGHTS	a. Classification system used – COICOP or a reconcilable version.				
	b. Classification system used for index compilation also used for household expenditure statistics.				
	c. Classification provides the framework for the allocation of expenditure weights.				
	d Weights derived from Household Budget Surveys and National Accounts estimates of household consumption expenditure.				
	e. If weight reference period differs from the price reference period weights are price updated.				
	f. Weights revised at least once every 5 years.				
	g. Continuous CPI series created by chaining when new basket replaces the old.				
	h. New models/varieties of existing product introduced once significant.				
	i. Seasonal products included in the basket (fixed or variable weights used).				

4. SAMPLING	a. Probability sampling used for item sampling if resources available.				
	b. If resources not available for probability sampling, judgemental sampling by statistician.				
	c. Sampling frames comprehensive and up-to-date				
	d. Sample of outlets and of items reviewed periodically and updated where necessary to maintain representativity.				
5. INDEX CALCULATION	a. The CPI is calculated starting with elementary aggregate indices.				
	b. Higher level indices are calculated by aggregating the elementary aggregates using expenditure weights.				
6. ELEMENTARTY AGGREGATES	a. Geometric Mean used for elementary aggregate indices. b. Ratio of Averages only used for elementary aggregates which are homogeneous and where there is little substitution. c. Average of Relatives not used.				
	b. Elementary index computed using chained form of the formula.				
7. UPPER LEVEL INDICES	a. Laspeyres-type index (current prices, historic weights) used.				
	b. Other index types for specific purposes?				
8. PRICE OBSERVATIONS	a. Standard methods for collecting and processing price information used.				
	b. Prices collected systematically and accurately at regular intervals.				
	c. Price collectors trained				
	d. Price collectors supervised				
	e. Manual available for price collectors				
	f. Same product priced in each period				

9. COLLECTION	a. Index relates to either monthly average prices or prices for a specific period of time within the month.				
	b. For perishable goods prices are collected at the same times of day and not just before closing time.				
	c. Price collection representative of all geographical areas within the scope of the index.				
	d. Prices collected in all type of outlets that are relevant, including open-air markets, informal markets, and internet sellers.				
	e. Specifications provided detailing the variety and size of the items for which prices are to be collected.				
	f. Prices collected are actual transaction prices, including indirect taxes and non-conditional discounts.				
	g. Exceptional prices charged for stale, shop-soiled, damaged or otherwise imperfect goods are excluded unless permanent and significant feature of retail market.				
	h. Genuine sale prices included.				
	i. Subsidised and controlled prices and unrestricted prices covered.				
	j. Alternative means of collection used for different items where appropriate, i.e. outlet visits, brochures, telephone, scanner data, internet.				
	k. Collected price information reviewed for comparability and consistency with previous observations, the presence of replacements, unusual or large price changes and to ensure price conversions of goods priced in multiple units are correct.				
	l. Consistent procedures established for dealing with missing price observations.				
	m. Estimated prices included for non-seasonal products that are temporarily unavailable.				
10. REPLACEMENTS	a. Items replaced when they disappear permanently.				
	b. Replacement made within the first three months of the item becoming unavailable.				
	c. Replacement selected from available criteria based on: the most similar item; the most popular variety; the most likely to be available in the future (state which).				
	d. Outlets replaced if price cannot be obtained.				

	e. Criteria in place for the selection of a replacement outlet and includes outlet type and location.				
11. QUALITY CHANGES	a. Relevant characteristics of items are recorded on an ongoing basis to ensure changes in quality are identified.				
	b. An adjustment is made to the price when a quality change is detected – the methods used to adjust are based on international guidelines.				
12. ACCURACY	a. Possible sources of errors actively identified and quantified.				
	b. Impact of possible error minimised in the design, construction and compilation of the index.				
13. DISSEMINATION	a. CPI compiled and released monthly.				
	b. Timetable for publication pre-announced.				
	c. CPI released as quickly as possible- within X weeks of the reference period.				
	d. CPI released to all users at the same time				
	e. CPI release accompanied by comments, interpretation and a short methodological explanation.				
	f. Rules relating to release made publicly available – including who has pre-release access (and details of this arrangement).				
	g. Corrections made and published if necessary i.e. if estimates have been seriously distorted by errors in compilation.				
	h. Planned revisions pre-announced and meta-data provided.				
	i. Publication should show the index level from the index reference period.				
	j. Indices for the major expenditure groups compiled and released.				
	k. National CPI results reported to the International Labour Office shortly after release.				
14.CONSULTATIONS AND INTEGRITY	a. The compiling agency has the professional independence, competence and resources to support the CPI programme.				
	b. The agency responsible consults users on issues of importance to the CPI, i.e. methodological changes.				
	c. A full description of the data collection procedures and methodology is widely available.				
	d. Users informed in advance of changes to scope, weights or methodology.				

Appendix 18.4 Project Prioritisation Tool

Ref	Project/ Output	Description	Frequency	Data Sources	Customers	Cost	Income	Impact	Legal	Savings	Strategy	Capacity	Score (%)	Comments	Effective	Efficient
	Headline description	Fuller description of the output, product, service or activity?	How often is the output produced or does the activity take place?	List the surveys (acronym and no.) and other sources used to compile the outputs	Who is the customer / user and what do they use it for? Identify internal customers as well as final external customer.	What does the product / service cost per year?	What income does it generate?	Impact on key stakeholders and customers / users? How important / valuable do they think it is?	Extent of legislative, regulatory or contractual obligation?	Savings elsewhere as a result of this project	How well does this fit with future NSI strategy	How well does this use NSI core skills and develop/ build future capacity for dealing with new challenges?		**Including comments on scope for making savings**	R/A/G	R/A/G
			M - Monthly Q - Quarterly A -Annual or list if none of the above		0 1 2 3 4	minimal(<$10k) low($10k-$25k) med($25k-$50k) high($50k-$100k) v high($100k+)	minimal(<$10k) low($10k-$25k) med($25k-$50k) high($50k-100k) v high($100k+)	minimal low medium high v high	not at all little medium strong non-negotiable	none low medium high v high	poorly not v well medium well v well	poorly not v well medium well v well	**MAX**			
					Weight	5	5	10	10	5	5	5	**180**			
Ref	**Project/ Output**	**Description**	**Frequency**	**Data Sources**	**Customers**	**Cost**	**Income**	**Impact**	**Legal**	**Savings**	**Strategy**	**Capacity**	**Score**	**Comments**	**Effective**	**Efficient**
1	Basket Update	Research into latest consumer trends: produce recommendations; collect prices and chain link.	Every 2 years	Household Budget Survey.	Central Bank for targeting inflation.	1	0	4	4	4	4	4	81%	A central bank requirement and international best practice.	AMBER	AMBER
2	Regional Price Indices	Indices for regional administrations and introducing at chain link	Q	Expanded price indices	Regional administration	4	0	1	0	0	0	0	17%	To inform pay settlements for government workers	RED	RED
3	Separate Price indices for goods & services	Separate sub-indices for goods and services published monthly from a re-analysis and re-weighting of prices data.	M	CPI prices data	Ministry of Finance and Central Bank	0	4	4	4	4	4	4	89%	Required to enact legislation on price control	GREEN	GREEN

Score: The 'score' column represents the sum of the value times the weight for each of the components divided by the maximum possible score (i.e. sum of all weights times 4). It can be used as a quick indication of which projects may provide the greatest/least value for money and where further discussions need to be focussed.

Effective: This column is used to get an indication of whether the project would be (or is) effective, i.e. whether its value to the user outweighs its cost. The column will display RED (not effective), AMBER (effective to some extent) or GREEN (highly effective), and is reached by the following process (the workings are not shown in the above table):

1. Calculations are made to reach a value for 'net cost' (cost minus income) and 'overall weighted value' (sum of impact x weight, legal x weight, strategy x weight and capacity x weight, divided by 10).
2. 'Net cost' is then assessed as High (>=2) given a score of 3, Medium (1, 0, -1) given a score of 2 or Low (<=-2) given a score of 1 and the overall weighted value as High (>=9) given a score of 3, Medium (5, 6, 7, 8) given a score of 2 or Low (<= 4) given a score of 1.
3. 'Effectiveness' is calculated as the result of overall weighted score (3, 2 or 1) minus net cost score (3, 2 or 1).
4. If the result of this formula is >=2 the effective rating is GREEN, if the result is 1, 0, or -1 the effective rating is AMBER, if the result is <=-2 the effective rating is RED.

Efficient: This column is used to get an indication of whether the project would be efficient, i.e. whether the cost is outweighed by the potential savings or income. The process for calculating this column is in essence the same as for the 'effective' column. Efficiency is calculated as the result of the savings score minus the net cost score. At step 2 'savings' assessed as Very High are given a score of 4, High a score of 3, Medium a score of 2 , Low a score of 1 and Minimal a score of 0. If the result of the calculation is >=2 the efficient rating is GREEN, if the result -1, 0 or 1 the efficient rating is AMBER, if the result is <=-2 the efficient rating is RED.

Appendix 18.5 Managing Risks in a Project

The management of risk is a major aspect of project management. If a project is to be a success, risks that the project objectives might not be met must be controlled and contained by actions designed to reduce the chances of problems arising and to alleviate their potential impact.

There are several stages in the management of risk:

Identification: Risks can be identified through a number of mechanisms but an initial 'horizon scan' for risks is a useful tool. Once identified risks should be documented in a 'risk log'. For instance, this might include the risks that a new CPI computer programme might not deliver the software required for planned methodological improvements to the index, or might not facilitate more efficient editing of prices data and a more-timely index.

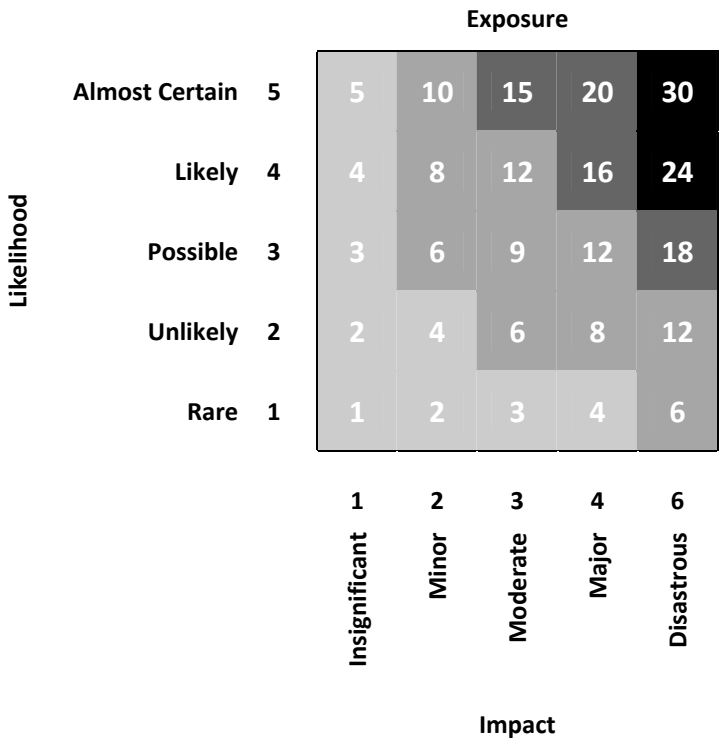
Evaluation: A risk should be assessed as to its likelihood (the probability of the risk becoming a reality) and impact (how critical is the result of a particular "risk" outcome actually happening). It is useful to score likelihood and impact to calculate an overall 'exposure', see Figure 18.5.1. This can help when deciding on what action to take in the next stage. For instance, if it is assessed during the course of a project that new CPI software is likely to lead to a less timely CPI which will not meet statutory requirements, this could warrant a top score of 30 and special action to be taken.

Respond: A decision must be made on what action to take, this can be to discount the risk (typically if the 'exposure' is low), to introduce countermeasures to stop the risk, or take action to control the impact of the risk if it occurs.

Monitoring: Risks that have been identified must be monitored to watch for signs that the risk is changing its status and to ensure that agreed responses or corrective actions are being applied. For instance, if it has been agreed that the module in the new CPI programme should be re-designed to facilitate more efficient automated data editing for increased speed, then checks need to be carried out that this has happened and that the re-design has achieved the desired objective.

All of the above stages are ongoing throughout the course of a project.

Figure 18.5.1 Risk Scoring Method



Glossary of Main Terms

Note: Words in **boldface** have their own entry in the glossary

Acquisition approach	In CPI construction relates to the time period in which products are acquired by a **household** (as opposed to when they are wholly or partially consumed), regardless of when the products are paid for. (See also **Payment approach** and **Uses approach**).
Ad valorem tax	A tax expressed as a percentage of the value of a **product**, as opposed to a flat-rate tax.
Aggregate	A set of transactions (or their total value) such as the total purchases of **households** on **goods** and **services** in a certain period.
Aggregation	The process by which **CPIs** for lower-level **aggregates** are averaged, or otherwise combined, to obtain **CPIs** for higher-level **aggregates**.
All-items index	The highest level of **aggregation** of a **CPI** which covers all the **items** within the **scope** of the CPI.
Average of relatives (AR)	See **Carli price index**.
Axiomatic (test) approach	The axiomatic or test approach to index number theory attempts to determine the most appropriate formula by reference to specific axioms or tests that the index should ideally satisfy.
Bargaining	A selling procedure where the transaction price is negotiated personally between buyer and seller. The final price and quantity are not known until the purchase has been made. Also known as "haggling".
Base period	The period with which all other periods are compared. See also "**price reference period**", "**weights reference period**" and "**index reference period**".
Basket	A specified set of quantities of **goods** and **services**. In the **CPI** context, the set may comprise the actual quantities acquired or used by **households** in some period, or may be made up of hypothetical quantities.
Bias	A systematic tendency for the calculated **CPI** to diverge from some ideal or preferred index, resulting from the method of data collection or processing, the index formulae used or some other aspect of index construction such as the treatment of changes in **quality.**
Black market	See "**Parallel market**".
Branded/unbranded goods	**Goods** which carry a label indicating the maker or distributor. The term is sometimes used to denote products whose maker or distributor is nationally or internationally well known. Goods which are not "branded" are called "unbranded".
Carli index	An **elementary price index** defined as a simple, or un-weighted, arithmetic average of the sample **price relatives**.
Carry forward	A situation in which a missing price in some period is imputed as being equal to the last price observed for that **item**.

Central collection	Collection of prices directly from **NSI** Headquarters. These usually concern products whose prices are determined by national organisations or government (e.g. fuel and transport charges) or by head offices of large retail chains.
Central product classification (CPC)	An international **classification** of **goods** and **services** based on the physical **characteristics** of goods or on the nature of the services rendered.
Chain index	An index number series for a long sequence of periods obtained by linking together index numbers spanning shorter sequences of periods. (See also "**chaining**").
Chaining/chain linking	The construction of a continuous price series by multiplying together price indices that have been constructed using different **weight reference periods**. The resulting index is referred to as a "**chain index**".
Characteristics	The tangible or intangible attributes of a **good** or **service** which serve to identify it and enable it to be classified. Some characteristics will help determine price and are commonly referred to as price-determining characteristics.
Class mean imputation	Imputation of a missing price by reference to the average price change for the price of a comparable **item,** usually from a similar **outlet.**
Classification of products	A procedure in which individual **items** of **goods** and **services** are organized into categories based on **characteristics** inherent to the items.
Cobb-Douglas function	A model of consumer behaviour in which **consumers** are assumed to vary the quantities of **products** consumed in inverse proportion to the changes in relative prices.
COGI (Cost-of-goods index)	An index in which a fixed **basket** of **goods** and **services** is priced each period, calculated as the cost of the basket in the comparison period divided by its cost in the reference period.
COICOP	The international Classification of Individual Consumption according to Purpose. It is required for use in national accounts complying with the **System of National Accounts (SNA 2008**) and is widely used for **CPI**s, **HBS**s, and in the **ICP.**
Consumer Price Index (CPI)	A monthly or quarterly price index compiled and published by a **National Statistical Institute** that measures changes in the prices of consumption **goods** and **services** acquired or used by **households**.
Consumers	Individual persons or groups of persons living together as **households**.
Consumption of own production	**Goods** or **services** that are consumed by the same **household** that produces them.
Commodity Flow method	A technique based on analysis of various national accounts aggregates designed to produce reliable estimates of expenditure weights where direct estimates are lacking or unreliable. See **product balance.**
Compensation Index	A **CPI** designed to be used primarily as a measure of inflation faced by employees, for informing wage negotiations or for **indexation** of wages.
Constant-tax index	A type of **CPI** which excludes price changes which are directly due to changes in indirect taxation.
Core inflation	A type of **CPI** which shows the underlying trend in inflation by excluding those movements which arise from transient factors such as seasonality or other short-term price volatility. Also known as "underlying" inflation.

Cost of living index (COLI)	An index which measures the change between two periods in the minimum expenditures that would be incurred by a utility-maximising **consumer** whose preferences or tastes remain unchanged, in order to maintain a given level of utility, standard of living or welfare.
Coverage	The set of **goods** and **services** of which the prices are actually included in a **CPI**. (See also **"Scope**").
Current value	The actual value of some **aggregate** in the period in question: the quantities purchased in the period multiplied by the prices in the same period.
CPI Manual	The international Consumer Price Index Manual published by the ILO in 2004 (ISBN 92-2-113699-X).
Cross-border shopping	Describes the situation where individual **consumers** travel to a neighbouring country in order to benefit from lower prices or the availability of different products from those obtainable in their domestic market.
Customer	The usual description in the Handbook of a **consumer** as an individual purchaser.
Data editing	The process of adjusting or eliminating price quotations input to the **CPI** calculation process. (See also **data validation**).
Data validation	The process of checking to ensure that all inputs to the **CPI** calculation process (especially prices), are correct. (See also **data editing**).
Deflation	The division of the current value of some **aggregate** by a price index ("deflator") in order to revalue its quantities at the prices of the **reference period**. The word is also used to describe the situation when the **CPI** trend is downwards (as compared with "inflation" when the trend is upwards).
Democratic index	A form of **CPI** in which each **household** is given equal **weight** in the calculation of the index, irrespective of the size of its expenditures. (see also "**plutocratic index**").
Disaster Recovery Plan	A contingency plan designed to ensure that the **CPI** can continue to be calculated and published when major unforeseen events occur.
Discount	A deduction from the list or advertised price of a **product** that is available to specific **customers** under specific conditions. Discounts include quantity discounts (e.g. additional volumes for the same price) as well as price discounts.
Domain	An alternative name for the **scope** of an index.
Domestic coverage	The use of **weights** covering all consumption expenditure on the national territory, regardless of the nationality or normal residence of the **consumer**. (See also **National population coverage**).
Durable good	A **good** that can be used repeatedly or continuously for purposes of consumption over a long period of time, typically several years.
Dutot index	An **elementary price index** defined as the ratio of the un-weighted arithmetic average of the prices in the two periods compared.
Elasticity of substitution	A measure of the extent to which one product is substituted for another in response to relative price changes. (See also **Substitutability**). A zero elasticity of substitution means that the quantities purchased will not change with price.

Elementary aggregate	The smallest **aggregate** for which expenditure data are normally available and used for **CPI** calculation to compute an elementary price index. The consumption expenditures associated with the **elementary aggregates** are used to weight the **elementary price indices** to obtain **higher level indices**.
Elementary price index	A price index for an **elementary aggregate**.
Evolutionary product	A product which is "**new**" in the sense that its features and "quality" differ from its predecessor. Examples of evolutionary products would be new models of household appliances such as refrigerators.
Expenditure weights	See "**Weights"**.
Explicit quality adjustment	A direct estimate of how much of the change in the price of a product is attributable to changes in its physical or economic **characteristics.** (See also "**Implicit quality adjustment**").
Fashion change which is not quality change	Changed **specifications** of **products** such as clothing or cars which may be considered as unchanged (and hence comparable) if they have no material effect on purpose or utility to the consumer, e.g. a change from one fashionable colour to another.
Fisher price index	The geometric average of the **Laspeyres price index** and the **Paasche price index**. It is a symmetric and superlative index.
Fixed basket index	A **CPI** which uses the same **basket** in each time period, normally consisting of the total quantities consumed by **households** over a period of a year.
Fixed weight index	A series of weighted arithmetic averages of **price relatives** that all use the same (constant) **weights**.
Goods	Physical objects for which a demand exists, over which ownership rights can be established, and for which ownership can be transferred between units by engaging in transactions on the market. (See also "**services**")
Haggling	See "**bargaining**".
Hedonic method	A regression model in which market prices of different **products** are expressed as a function of their **characteristics**. The resulting estimates may be used to predict the price of a **new product** for which the mix of characteristics differs from those of any product already on the market, and can thus be used to estimate the effects of **quality change** on prices.
Heterogeneity	See "**Homogeneity".**
HICP	The European Union Harmonized Index of Consumer Prices, developed to ensure comparability of **CPIs** among members of the EU.
Higher level index	An **aggregate** price index as distinct from an **elementary price index**.
Homogeneity	The similarity of products in a group in terms of price (both levels and trends), purpose, price-determining characteristics and **substitutability**. The opposite is "**heterogeneity**"**.**
Household	Either an individual person living alone or a group of persons living together who make common provision for food and other essentials for living.
Household Budget Survey (HBS)	A sample survey of **households** in which households are asked to provide data on the amounts they spend on consumption products over a given period or periods of time.

Household consumption expenditure	Expenditure on final consumption **goods** and **services** incurred by individual **households** on their own behalf. It excludes expenditure by governments and non-profit institutions on goods and services provided to households as free social transfers in kind.
ICP	The International Comparison Program for **purchasing power parities,** designed to produce PPPs enabling international economic comparisons to be made without the distorting effect of differing price levels and consumption patterns.
ILO Resolution	In this Handbook, it refers to the ILO's Resolution concerning Consumer Price Indices adopted by the 17th International Conference of Labour Statisticians, 2003.
Implicit quality adjustment	Inferring indirectly the change in the quality of a product whose **characteristics** change over time by estimating (or assuming) the **pure price** change that has occurred. (See also "**Explicit quality adjustment"**).
Imputed price	The price assigned to an **item** for which the price is missing in a particular period. The same term is also applied to the price of an item that is not sold on the market, such as a **good** produced for **own consumption.**
Imputed rent	The rent which an **owner-occupied** dwelling may be expected to fetch if it were let on the open market. Used as an estimate of the shelter costs of owner-occupiers.
Imputed transaction	A situation where, in order to **impute** a price, the transaction itself has to be an imaginary one. An example is the valuation of **own account consumption**.
Indexation	The periodic adjustment of the money values of some regular scheduled payments (such as wages, pensions, rents etc.) based on the movement of the **CPI** or other price index.
Index reference period	The period for which the value of the **CPI** is set at 100.
Institutional unit	A national accounts concept defined as an economic entity that is capable, in its own right, of owning assets, incurring liabilities and engaging in economic activities and transactions with other entities.
Item	An individual, specified **good** or **service** in the sample of **products** selected for pricing.
Jevons price index	An **elementary price index** defined as the un-weighted geometric average of the sample **price relatives**.
Laspeyres price index	A basket index in which the **basket** is composed of the actual quantities of **goods** and **services** in the earlier of two periods to be compared (the **price reference period**).
Linking	Connecting together two consecutive sequences of price observations or price indices which overlap in one or more periods.
Lowe price index	A **CPI** that measures the proportionate change in the total value of a specified **basket** of **goods** and **services** between the two periods being compared. The basket does not necessarily have to consist of the actual quantities in some period.
Lower level index	An **elementary price index** as distinct from an **aggregate** or **higher level index**.
Matched pairs	See "**matched products or models**".

Matched products or models	The practice of pricing exactly the same **item** in two or more consecutive periods. It is designed to ensure that the observed price changes are not affected by quality change. The change in price between two perfectly matched products is described as a "**pure price change"**.
Matched samples	A variation of the "**matched pairs**" concept in **tariff** pricing, when a full tariff list or an element of the tariff structure is treated as a "product **specification**" and re-priced in subsequent periods.
Micro-index/micro-class	An index/class relating to groupings below the **sub-index** level
National population coverage	The use of **weights** covering the expenditure of national residents of a country, regardless of where the expenditure is made (see also "**Domestic population coverage"**).
National Statistics Institute (NSI)	Title used in this Handbook to describe the statistical agency which is responsible for compiling the official **CPI** (and usually other national statistics) of a country.
New product	A "new product" may be of a **revolutionary** or **evolutionary** type. It may also be a product which has been introduced into a country's **CPI** because it has become widely consumed.
Non-probability sampling	A sample design based on the non-random, selection of a sample of **outlets** or **products** on the basis of the knowledge or judgment of the person responsible. (Also known as "**purposive**" or "**judgmental"** sampling).
Option costing	A method of **quality adjustment,** used particularly for **durables** such as motor cars, in which the prices of specific options (such as air-conditioning) are used to enable price comparisons of hypothetical models which have identical **specifications**.
Outlet	The interface between a supplier of products and the **consumer**. It may be a shop, a market stall, a catalogue, a website etc. Also referred to as a "retail outlet", although it can include wholesale outlets which also sell directly to the consumer.
Outlier	A term used to describe any extreme value in a set of data, such as a price or price relative that requires further investigation or has been verified as correct.
Overall mean imputation	Imputation of a missing price by reference to the average price change for the prices available in the **elementary aggregate** to which the missing **item** belongs.
Overlap pricing	A method of **quality adjustment** based on the difference in price between the old **product** and its **replacement** when both can be priced simultaneously. Also referred to as the "bridge overlap" method.
Own account production/consumption	**Goods** produced by **households** for their own consumption.
Owner-occupied housing	Dwellings owned by the **households** who live in them.
Paasche price index	A basket index in which the **basket** is composed of the actual quantities of **goods** and **services** in the later of the two periods compared. The later period serves as the **weight reference period** and the earlier period as the **price reference period**.
Parallel market	Unofficial (and often illegal) markets where **goods** can be obtained at lower than usual prices, or where goods in short supply can be obtained at higher than usual prices. Also known as "**Black market**".

Payments approach	In CPI construction relates to the time period in which actual payments for a **product** are made by the consumer. (See also "**Acquisition approach"** and "**Uses approach"**).
Plutocratic index	A form of **CPI** in which the **weights** are based on total aggregated expenditure values rather than average household expenditure proportions. (See also **"Democratic index").**
Price reference period	The period for which the prices appear in the denominator of the price relatives. (See also "**Base period**").
Price relative	The ratio of the price of an **item** in one period to the price of that same item in some other period.
Price updating	A procedure whereby the quantities in an earlier period are re-valued at the prices of a later period, using components of the CPI.
Probability proportional to size sampling (PPS)	A sampling procedure whereby each unit in the universe of those units has a probability of selection proportional to the size of some known variable, such as the value of the sales of an **outlet**.
Probability sampling	The random selection of a sample of units, such as **outlets** or **products**, in such a way that each unit in the universe has a known (non-zero) probability of selection.
Product	A generic term used to mean a **good** or a **service**. Individual sampled products selected for pricing are often described as "**items**".
Product balance	SNA 2008 uses the term **product balance** rather than **commodity flow** and defines it as follows, "the product balance for any product recognizes that the sum of output at basic prices plus imports plus trade and transport margins plus taxes on products less subsidies on products is equal to the sum of intermediate consumption, final consumption and capital formation, all expressed at purchasers' prices, plus exports."
Purchaser's price	The amount payable by the purchaser to acquire a **good** or **service**. It includes any charges incurred in order to take delivery at the time and place required by the purchaser.
Purchasing power (internal)	Changes in the internal purchasing power of a national currency are the inverse of changes in the price level: when prices rise, the amount which can be purchased with a given sum of money falls, and vice versa.
Purchasing power parities (PPPs)	Artificial exchange rates which eliminate the distorting effect of differing price levels and consumption patterns when making international economic comparisons.
Pure price change	The change in the price of a **product** of which the **characteristics** are unchanged; or the change in the price after adjusting for any change in quality.
Quality adjustment	An adjustment to the change in price of a **product** of which the **characteristics** change over time, designed to remove the contribution of the change in characteristics to the observed price change. The adjustment is needed when the price of a **replacement product** has to be compared with the price of a replaced product.
Quantity weights	A term sometimes used to describe the quantities in the **basket**. However, expenditures rather than quantities act as **weights** for **price relatives**.

Quota sampling	Sample selection using judgmental procedures with respect to known **characteristics** such as **product** group or **outlet** type. The sample is drawn so as to contain the same proportions as in the total population of products or outlets.
Ratio of averages (RA)	See "**Dutot price index".**
Ratio of geometric means (GM)	See "**Jevons price index".**
Rebasing	Rebasing may have different meanings in different contexts: • Changing the **weights** used for a series of indices; • Changing the **price reference period** used for a series of indices; • Changing the **index reference period** for a series of indices, for instance from 1990=100 to 2005=100. Rebasing can involve the simultaneous changing of both weights and the **price reference period**.
Reference population	The set of **households** included within the **scope** of the **CPI**.
Remuneration in kind	The regular provision of **goods** or **services** in exchange for labour services rendered, often operating as part of a contract of employment).
Rental equivalence	The estimation of the **imputed rents** which would be payable by **owner-occupiers** on the basis of the market rents payable for accommodation of the same type and location.
Replacement product	A product chosen to replace a product for which prices have been collected previously, either because the previous product has disappeared altogether or because it accounts for a diminishing share of the sales of the **outlet**, or of the expenditures within the **elementary aggregate.**
Representative product	A product, or category of products, that accounts for a significant proportion of the total expenditures within an **elementary aggregate**, and/or for which the average price change is expected to be close to the average for all products within the aggregate.
Representativity bias	**Bias** in a basket index which results from the use of quantities that are not representative of the two periods being compared, i.e. that systematically diverge from the average quantities consumed in the two periods.
Respondent	In the context of retail **outlets**, the proprietor, manager or shop assistant is sometimes referred to as the respondent. In the context of **Household Budget Surveys**, the respondent is the **household** or household member who completes the forms.
Revolutionary product	An entirely **new product** that is expected to satisfy some need in a new way and is unlikely to fit neatly into an existing **CPI item** category, such as video recorders or mobile telephones (when they were first produced). See also "**Evolutionary product**".
Re-weighting	Replacing the **weights** used in an index by a new set of weights.
Rolling year index	An index based on average prices and quantities in moving 12-month periods compared with base year averages. Used for dealing with **seasonal products**.
Rothwell index	A type of **variable weights** method used for dealing with **seasonal products**. Also known as the Bean and Stine Type C index.

Sampled product	An individual **product** that is included in the sample selected for pricing within an **elementary aggregate**. Also referred to as an **"item".**
Sample rotation	A method of keeping the sample up to date by limiting the length of time that **outlets** and/or **products** are included in the price surveys by dropping a proportion of them (or possibly all of them) after a certain period of time and selecting a new sample of outlets and/or products.
Sampling frame	A list of the units in the universe from which a sample of units can be selected. The list may contain information about the units, which may be used for **PPS** sampling. In a **CPI**, the units are normally outlet types, **outlets** and **products**.
Scanner data	Detailed data on sales of consumer **goods** obtained by scanning the barcodes for individual **items** at electronic points of sale in retail **outlets**. Increasingly used for **hedonic** analysis.
Scope	The set of **products** and **household** types for which a **CPI** is intended to measure the price changes. (See also "**Coverage**").
Seasonal adjustment	The removal of seasonal influences from a **CPI,** done in order to provide a clearer picture of the underlying trend in the index. Not to be confused with the treatment of **seasonal products**. (See also "**Core inflation**".)
Seasonal products	**Products** that are either not available on the market during certain seasons or periods of the year, or are available throughout the year but with regular and significant fluctuations in the quantities available or in demand and prices that are linked to the season or time of the year. (See also "**Seasonal adjustment**").
Services	Services (as opposed to **goods**) are **products** which do not have a physical presence. A pair of scissors is a good, but the use of them in cutting hair is a service. Services may be characterised by: perishability – they cannot be stored up; lack of separability – it is impossible to separate the production and consumption of a service; uniqueness – the **quality** of services can differ each time they are delivered.
Simple random sampling (SRS)	Type of sample selection when **outlets** or **products** are sampled with equal probability. It can be used when all the outlets or products are **homogeneous.**
Specification	A description or list of the **characteristics** that can be used to identify an individual sample **product (item)** to be priced. A "tight" **specification** is a fairly precise description, intended to narrow the range of items from which a price collector might choose. A "loose" specification is a generic description of a range of items that allows the collector some discretion as to which particular item or model to select for pricing.
Splicing	The imputation of an overlap price for a **product** no longer available in the current period, by reference to the price changes between the previous and current periods of similar **items**. Also known as **"linking", "overall mean imputation" and "**non-class mean imputation".
Stratification	The division of **heterogeneous** populations of **outlets**, regions or products into a number of relatively homogeneous populations (strata). The group of strata can then be used as a frame for **stratified random sampling**.
Structured Product Description (SPD)	A tool used first in the **ICP** to standardize the **specifications** of products for which prices are sought, adapted for use with **CPI** price collection.
Sub-aggregates	Indices produced at levels of aggregation in between the **elementary aggregate** level and the **all-items index** level.

Sub-index	A general name used in the context of a **CPI** which relates to a relatively detailed product or other **stratum** level.
Subsistence index	A special **CPI** whose **weights** relate to the expenditure patterns of the poorest **households**.
Substitutability	The extent to which **consumers** substitute one **product** for another in response to relative price changes. (See also "**Elasticity of substitution"**).
Substitute	An **item** or **product** of which the **characteristics** are similar to those of another item or product and that can be used to meet the same kinds of consumer needs or wants.
Substitution	The replacement in **consumer** purchases of **products** by **substitutes**, typically in response to changes in relative prices.
Substitution bias	The **bias** which results when a basket index is used to estimate a **cost-of-living index**, because a basket index cannot take account of the effects on the cost of living of the **substitutions** made by **consumers** in response to changes in relative prices. Sometimes also used more generally in the context of all CPIs.
Substitution effect	The effect of **substitution** on the value of a **CPI**.
Superlative index	A type of index which approximates to a cost-of-living index. They are generally symmetric indices, i.e. they treat both the base and current periods symmetrically by attaching equal importance to the price and expenditure data in both periods.
Systematic (interval) sampling	Type of sample selection when **outlets** or **products** are chosen with equal probability, but sampling units are selected at equal "distances" from each other in the **sampling frame**, with only the first unit being randomly selected. It can be used when the outlets or products are **homogeneous.**
System of National Accounts	A coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, **classifications** and accounting rules.
Tariff	A list of pre-established prices and conditions for the purchase of certain **goods** or **services** which has been fixed by the supplier to exert influence on consumption patterns by means of differentiated prices and conditions according to the characteristics of **consumers** or to the level, the structure or timing of the consumption.
Tax-exclusive index	A type of **CPI** which excludes indirect taxes entirely, by removing from both the prices and the **weights,** those elements which are accounted for by taxes. This type of an index is sometimes also referred to as a net-price index.
Törnqvist price index	A symmetric index defined as the weighted geometric average of the **price relatives** in which the **weights** are simple arithmetic averages of the expenditure shares in the two periods.
Trimmed index	A **CPI** which has had extreme prices or price changes removed, thereby giving more weight to the central values, which may be regarded as more typical and hence suitable as a measure of underlying inflation.
Tukey algorithm	A method of filtering data as part of a **data validation and editing** process.
Unit value (average value)	The total value of the purchases/sales of a set of **homogeneous products,** divided by the sum of the quantities. It is thus a quantity-weighted average of the different prices at which the products are transacted. A price index based on unit values is known as a "unit value index".

User cost	The cost incurred over a period of time by the owner of a fixed asset or consumer **durable** as a consequence of using it to provide a flow of capital or consumption services. It consists mainly of the depreciation of the asset or durable, plus the capital cost or interest.
Uses approach	An approach to **CPIs** in which the consumption in some period is identified with the consumption of **goods** and **services** actually used up by a **household** to satisfy their needs and wants. (See also "**Acquisition approach**" and "**Payments approach**").
Variable weights	A technique used in dealing with **seasonal products**, under which **weights** vary from month to month according to seasonal consumption patterns. One particular type is known as the **Rothwell index**.
Weights (or expenditure weights)	The weight of a **product** in a CPI is the proportion of total household expenditure which is spent on that product during the **weight reference period**. It may be defined so as to measure the un-weighted average of all households' expenditure proportions or so as to measure the average proportion of total household expenditure on that product. (See "Democratic index", "Plutocratic index" and "quantity weights").
Weight reference period	The period for which the expenditure shares serve as the **weights** for a **CPI**.
Young Index	This is a weighted version of the **Carli index**.

PRACTICAL GUIDE TO PRODUCING CONSUMER PRICE INDICES

A Supplementary Handbook to the Consumer Price Index Manual

This Handbook gives practical guidance on all aspects of compiling a consumer price index, focusing on the special issues facing compilers of CPIs in the developing world. It offers advice on operational issues ranging from the sampling of outlets and of the products to be priced, to subsequent price collection and through to the calculation of elementary and higher-level price indices and final publication.

The Handbook also provides practical guidance on specific areas of CPI compilation which can be problematic, including dealing with missing price observations, the treatment of seasonal products, adjustment for quality change and methods of dealing with difficult-to-measure products such as own-account consumption, second-hand goods, owner-occupier housing, telecommunications, cars and computers.

Although targeted at compilers of CPIs in developing countries the Handbook will also be of interest to compilers more generally. It supplements the international CPI Manual (ILO, IMF, OECD, UNECE, Eurostat, World Bank, 2004).

The electronic version of the publication is available on:

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