Harmonised Index of Consumer Prices (HICP)

METHODOLOGICAL MANUAL

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Foreword

The *HICP Methodological Manual* represents a comprehensive overview of methods that are used in the compilation process for the harmonised index of consumer prices (HICP). The manual intends to be a practical guide to all steps necessary to produce an HICP and is thus useful for statisticians who are new to the field of price statistics and statistical offices aiming to set up a similar inflation measure. Users of the HICP, such as businesses, policy-makers and researchers may also find this manual useful to help them understand and interpret HICP data.

The drafting of the *HICP Methodological Manual* has been co-ordinated by Eurostat and supervised by a dedicated task force that was composed of experts from the statistical institutes of France, Germany, Italy, Luxembourg, the Netherlands, Norway, Portugal, the United Kingdom and the European Central Bank. The task force met several times during the two years of the drafting process and discussed the content of every single chapter in depth. Two dedicated workshops, in which all EU Member States participated, were held to discuss the draft manual. The drafting work was carried out by a team of international experts and Eurostat.

Eurostat would like to thank the experts and the task force members for their commitment during the drafting process of the manual, as well as all others who contributed in the form of comments or suggestions.

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Aim and history of the HICP

1.1   Introduction

Consumer price indices (CPIs) measure changes in the prices of goods and services that households acquire for consumption. They are used for a wide variety of purposes, such as conducting monetary policy; indexing commercial contracts, wages, social protection benefits and financial instruments; deflating national accounts aggregates; and, more generally, expressing monetary values in real terms.

Within the European Union (EU), a specific CPI has been developed — the harmonised index of consumer prices (HICP). The HICP is calculated according to a harmonised approach and a single set of definitions. The key HICP aggregates are the euro area index, covering the countries whose currency is the euro, and the national HICP for each of the EU Member States. The national statistical institutes produce the national HICPs, while Eurostat produces the country-group aggregates. The production of the HICP, its methodology and the data to be sent to Eurostat are governed by EU law.

This chapter outlines the aim and history of the HICP and notes some key elements of the harmonisation process.

1.2   Aim of the HICP

The HICP was set up to provide a high-quality, comparable measure of consumer price inflation. It serves two main purposes.

- It is used to quantify the definition of price stability in the European Central Bank's (ECB) monetary policy strategy. Maintaining price stability is the primary objective of the ECB and the national central banks of the euro area, as set out in the Treaty on the Functioning of the European Union [1]. In 1998, the Governing Council of the ECB announced the following definition: 'Price stability shall be defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2 %. Price stability is to be maintained over the medium term'. Following a thorough evaluation of its monetary policy strategy in 2003, the Governing Council further specified that, within that definition, it aims to keep inflation rates 'below, but close to, 2 % over the medium term'.

- It is used to assess price convergence with a view to a country's joining the monetary union. In addition to these specific EU uses, it may be used, like other consumer price indices, for economic analysis and for indexing contract prices.

1.3   The history of the HICP

The HICP has been produced and published since March 1997, but attempts at harmonising CPIs stretch further back.

In the mid-1970s, Eurostat saw the need to harmonise CPI methodologies and pushed for it. One of the early initiatives was a Eurostat-commissioned report [2] that reviewed how the then nine Member States constructed their CPIs. In the late 1980s, the International Labour Organisation (ILO) devoted considerable efforts to the development of the theory and practice of CPIs. The ILO's work led to the publication in 1989 of an important CPI manual [3]. While highlighting the conceptual and practical issues involved in designing CPIs, the manual left it to individual countries to resolve these as they deemed appropriate for their purposes. It did not, therefore, directly lead to greater comparability in practice. At about the same time, in 1988, Eurostat commissioned a further report on the prospects for harmonising CPI methodologies [4].

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[1]   Here and in the following see: ECB, The monetary policy of the ECB, 2011, p. 64.

[2]   Eurostat, Consumer Price Indexes in the European Community — Comparison of existing indexes and approaches to their harmonisation, Josef Stadlbauer, Luxembourg, March 1975.

[3]   ILO: *Consumer price indices: an ILO manual*, Ralph Turvey, Geneva, 1989.

[4]   Eurostat: 'Consumer Price Indices in the European Community – Similarities and proposals for harmonisation'[], Rudolf Teekens, Luxembourg, January 1989.

These attempts by Eurostat and the ILO did not lead to any consensus on the best way of calculating comparable indices. Countries were either unwilling or unable to change a key statistic like the national CPI to serve the then limited purpose of international comparison.

This situation changed in 1992, when the Maastricht Treaty laid down criteria for joining the euro area (i.e. stage III of economic and monetary union (EMU)). One such criterion was sustainable convergence in price stability, to be assessed in comparison with the best performing Member States.

So, with the Maastricht Treaty, it became imperative to compare consumer price inflation between Member States, unaffected by differences in the way it was measured. A harmonised CPI was needed because the national indices had developed over the years in many different ways, reflecting national needs and circumstances. Though they met national needs, they were demonstrably not comparable with each other.

In 1993, the first attempt was made to establish new harmonised CPIs based on a uniform set of rules, binding on all Member States. The Statistical Programme Committee (SPC), the predecessor of the European Statistical System Committee, dismissed this proposal. National CPIs had been designed for a variety of national purposes and were politically sensitive, sometimes to the extent of being protected by law. Citing Protocol No 6 on the convergence criteria referred to in Article 109j(1) of the Maastricht Treaty, which stipulates that 'inflation shall be measured by means of a consumer price index on a comparable basis, taking into account differences in national definitions', the SPC endorsed Eurostat's initial proposal that the requirement be met through the implementation of HICPs based on the national CPIs.

On 23 October 1995, the European Union's Council of Ministers adopted Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices [5], providing the legal basis for the establishment of a harmonised methodology for compiling consumer price indices for the Member States of the European Economic Area [6]. The Regulation laid down basic definitions, the scope of the indices, the timetable and frequency for their production and publication. It also provided for further methodological improvements of the HICP using minimum standards. The minimum standards laid down in the implementing regulations specify the outputs to be provided, but leave it to Member States to decide how to achieve this. In the years after 1995, some 20 implementing regulations were adopted [7], each addressing specific areas of methodology. Priority was given to the issues thought most likely to be of longer-term importance.

Regulation No 2494/95 was implemented in two stages. In 1996, Member States compiled interim indices of consumer prices, to provide early results for inflation comparisons pending more harmonised indices. In 1997, the HICP replaced the interim indices.

In the interim indices, certain categories of expenditure were excluded if there was not enough time to reach agreement on how best to construct comparable measures. For example, the expenditure faced by owner-occupiers when acquiring housing, which was not covered in some countries, measured by imputed rents in others, and by mortgage interest payments in the rest, was entirely excluded. Expenditure on health and education was also excluded, because of major institutional differences between countries in the ways in which consumers pay for such services: either directly (with or without subsidies) or via direct taxes such as income tax.

In addition to the exclusions listed above, certain products and some other categories of expenditure were not covered in some national CPIs, in particular, alcoholic drinks and tobacco. The countries concerned added these products to their interim HICP.

The interim indices were compiled throughout 1996 (with retrospective data from 1994) by all the then Member States plus Iceland, Norway and Switzerland.

In line with Regulation No 2495/95, the official HICP started with the index for January 1997. Eurostat published the first set of official HICPs on 7 March 1997 (with retrospective data from January 1995). In contrast to the interim indices, the HICP was harmonised in several methodological areas, as well as coverage. So it did not simply expand the interim indices but was a new and different index.

[5]   OJ L 257, 27.10.1995. p. 1.

[6]   http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31995R2494&from=EN

[7]   http://ec.europa.eu/eurostat/web/hicp/publications/compendium

Regulation No 2494/95 was repealed in May 2016, when the EU adopted a new basic act for the HICP — Regulation (EU) No 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index [8]. (The 'Framework Regulation').

The new act simplified and clarified legal requirements for the compilation of the HICP and other harmonised indices, and provided for a modernisation of the framework in order to adapt it to new requirements. In particular, it improved the framework for quality assurance, and gave a legal basis to a more detailed classification for the HICP, the European classification of individual consumption according to purpose (ECOICOP — see Section 2.3.3). It also required euro area Member States to provide flash estimate data, and all Member States to provide the information needed to compile HICP-administered prices [9].

1.4   The harmonisation process

The programme to develop a harmonised methodology for the HICP has relied on the active participation of Member States and CPI experts, coordinated and led by Eurostat.

The Price Statistics Working Group (known as the HICP Working Group until 2012) is the principal forum for developing the HICP. The Working Group includes representatives of Eurostat, the Member States, European Economic Area and candidate countries. User representatives — from the ECB, national central banks and the Commission's Directorate-General for Economic and Financial Affairs also participate. Other international organisations (the IMF, UNSD, ILO, OECD, and UNECE) are invited to the meetings as observers. The harmonisation work was also supported by a range of specific task forces set up to further the methodological work or contribute to drafting legislation, recommendations and other guidelines. The European Advisory Committee on Statistical Information in the Economic and Social Spheres was also involved in the early years. As required by EU law, the opinion of the European Statistical System Committee is sought for all implementing regulations.

The implementing regulations established since the 1995 Framework Regulation cover a number of technical issues that Member States needed to address: product coverage, the classification to be used, the formulas for the elementary aggregates, treatment of missing price observations, minimum standards for the quality of weights, and the treatment of tariff prices, etc. Table 1.1 lists them.

In particular, the HICP's product coverage has expanded in stages since its initial launch. With effect from the January 2000 index, the coverage of goods and services was extended to include the following services which had previously been excluded: out-patient services (ECOICOP Group 06.2), some education services such as university tuition fees (part of Division 10), childcare services (part of Group 12.4) and insurance services (Group 12.6).

Further extensions to coverage took place with effect from the January 2001 index, with the inclusion of hospital services and nursing homes (Group 06.3) and retirement homes (part of Group 12.4).

From January 2002, the HICP included service charges expressed as a proportion of the transaction value, e.g. unit trust and stockbrokers' charges, and foreign currency exchange commission (part of Group 12.6).

In December 2016 there were 13 implementing regulations in force that the EU Member States must apply when producing their HICP (see Table 1.1).

[8]   OJ L 135, 24.5.2016. p. 11.
[9]   The HICP-administered prices is covered in Chapter 9.

Table 1.1 HICP implementing regulations in force

Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices[1]

Commission Regulation (EC) No 2214/96 of 20 November 1996 concerning harmonised indices of consumer prices: transmission and dissemination of sub-indices of the HICP[2]

Commission Regulation (EC) No 2646/98 of 9 December 1998 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of tariffs in the Harmonised Index of Consumer Prices

Commission Regulation (EC) No 1617/1999 of 23 July 1999 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of insurance in the Harmonised Index of Consumer Prices and modifying Commission Regulation (EC) No 2214/96

Council Regulation (EC) No 2166/1999 of 8 October 1999 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of products in the health, education and social protection sectors in the Harmonised Index of Consumer Prices

Commission Regulation (EC) No 2601/2000 of 17 November 2000 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the timing of entering purchaser prices into the Harmonised Index of Consumer Prices

Commission Regulation (EC) No 2602/2000 of 17 November 2000 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of price reductions in the Harmonised Index of Consumer Prices[3]

Commission Regulation (EC) No 1920/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of service charges proportional to transaction values in the Harmonised Index of Consumer Prices amending Commission Regulation (EC) No 2214/96

Commission Regulation (EC) No 1921/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for revisions of the Harmonised Index of Consumer Prices and amending Regulation (EC) No 2602/2000

Commission Regulation (EC) No 1708/2005 of 19 October 2005 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the common index reference period for the Harmonised Index of Consumer Prices and amending Commission Regulation (EC) No 2214/96[4]

Council Regulation (EC) No 701/2006 of 25 April 2006 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the temporal coverage of price collection in the Harmonised Index of Consumer Prices

Commission Regulation (EC) No 330/2009 of 22 April 2009 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of seasonal products in the Harmonised Index of Consumer Prices

Commission Regulation (EU) No 1114/2010 of 1 December 2010 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the quality of Harmonised Index of Consumer Prices weightings and repealing Commission Regulation (EC) No 2454/97

[1] *Amended by Council Regulation (EC) No 1687/98, Council Regulation (EC) No 1688/98, and Commission Regulation (EC) No 1334/2007.*
[2] *Amended by Commission Regulations (EC) No 1617/1999, No 1749/1999, No 1920/2001, and No 1708/2005.*
[3] *Amended by Commission Regulation (EC) No 1921/2001.*
[4] *Amended by Commission Regulation (EU) No 2015/2010.*

In addition to the regulations that the Member States must implement, Eurostat works with the Member States to steadily improve the quality of the indices on a voluntary basis. This work consists of seeking agreement on recommendations on the treatment of different product groups and on the use of new data sources and methods by organising workshops to discuss different HICP-related issues and share knowledge and good practice. Additionally, Eurostat supports financially the Member States' methodological and technical improvement projects in the area of index production.

1.5   Procedures

At EU level, the European Parliament and the Council (sometimes referred to as 'the co-legislators') can use the 'ordinary legislative procedure' to adopt measures for the production of statistics needed for the EU's activities (see Article 338(1) of the Treaty on the Functioning of the European Union).

For the HICP, the Council and Parliament have given the Commission some implementing powers under Regulation No 2016/792. In the Commission, Eurostat, the statistical office of the European Union is responsible for statistics and the HICP comes under the unit *Price statistics; Purchasing power parities and Housing statistics,* in Eurostat's Directorate for *Macro-economic Statistics*;

All HICP-related Commission implementing acts are adopted subject to the 'examination procedure', which means they must first receive a positive opinion following a vote in the European Statistical System Committee (ESSC).

When drafting new implementing acts and, in general, to guarantee the quality of the HICP and further develop it, Eurostat draws on advice from outside experts in addition to in-house expertise. This advice may be provided by expert groups and external consultants, or may take the form of special studies. Consultation with stakeholders follows the normal Commission rules.

The relevant expert groups [10] for the HICP are the Directors of Macroeconomic Statistics (DMES) and the Price Statistics Working Group (PSWG).

The DMES has a strategic role in guiding and coordinating work on national accounts and other macroeconomic statistics, including the HICP. It acts as an intermediary between activities at more technical levels and the ESSC.

The main expert group for the HICP at operational level is the PSWG. Its remit covers the HICP and housing price indices. It helps Eurostat to draw up HICP regulations and other HICP-related initiatives. The group agrees on standards for the methodology, compilation and dissemination of the HICP. It also gives advice on how best to ensure the HICP is of high quality and complies with the standards. Group meetings are used to exchange information, experience and good practice. The PSWG can set up task forces to handle specific HICP issues. These task forces are normally temporary and have fewer members than the PSWG. They report back to the PSWG.

Given the importance of accuracy, reliability and comparability for the HICP, Eurostat systematically monitors Member States' compliance with the legal requirements. Compliance monitoring is based on detailed documentation, analysis of data and methods, and visits to Member States to discuss with those responsible for producing the HICP there. Eurostat publishes the reports [11] on its website.

[10]   For further information on expert groups see: http://ec.europa.eu/transparency/regexpert/.

[11]   http://ec.europa.eu/eurostat/web/hicp/methodology/compliance-monitoring

2

HICP concepts

2.1 Introduction

This chapter describes the general concepts underlying the HICP. It also covers some general issues that are not dealt with in detail in the other chapters, such as the concept of comparability and the domestic concept of consumption expenditure. Furthermore, it introduces in summary form some topics that are dealt with in more detail in the other chapters.

2.2 General concepts

2.2.1 The measurement target

The HICP is designed to be a measure of pure price change for goods and services (generally termed products) falling within the scope of household final monetary consumption expenditure (HFMCE) on the economic territory. This means it is essential for the HICP that it refers to monetary transactions only ([12]).

The HICP is a cost of goods (and services) index (or COGI), i.e. it measures the changing cost of a *fixed basket of products* at different sets of prices over time. The HICP is not designed to be a cost of living index (or COLI). The COLI approach would theoretically involve comparisons of different baskets providing the same level of utility.

Given its primary use as a macroeconomic indicator for monetary policy, a COLI approach was never seen as an option for the HICP. Because the HICP compares prices by measuring the cost of a fixed basket of goods and services, this implies that the price relatives should follow identical or almost identical product offers; that is, the product offers should remain of similar specification or quality. That way, the price changes recorded are *pure price changes*, i.e. they are unaffected by differences in the quality of the product offers priced.

The basket can be viewed as consisting of two levels. Level I is comprised of product groups and their respective weights, which are organised according to the ECOICOP classification. Level II (below the 5-digit level), by contrast, uses no pre-defined classification system. The availability of detailed expenditure data by product, the sampling approach used and resource availability will often dictate how an individual country decides to organise and structure its classification system at this lower sub-5-digit level. Regardless of how Level II is organised, a series of elementary aggregates (EAs) must be created and exist somewhere within that Level II structure. EAs are the building blocks of the HICP (see Chapter 3 — Weights).

At the elementary aggregate level and above, the product descriptions and the expenditure weights remain unchanged or *fixed*, at least in between periodic reviews. Below the level of the elementary aggregate are the product offers, which are priced each month. These may or may not be implicitly weighted. Chart 3.1 at the end of Section 3.3.1 shows these two levels in graphical form.

New products and product offers frequently appear on the market, while others disappear. Their dynamics cannot be ignored without risking a degradation of the sample. When a product offer in the sample is no longer available or no longer popular, it needs to be replaced, with possibly a quality adjustment, to keep the sample representative.

When making such replacements, it is essential to follow the HICP principle of comparing prices of product offers on a like-with-like basis so to reflect pure price changes.

Replacement product offers should be either identical or essentially equivalent to the one replaced. That is they should be either the same or similar enough in terms of their characteristics that consumers perceive them to be equivalent. Where, from the consumer perspective, a replacement product offer is not seen as equivalent, i.e. its characteristics differ from the replaced product offer, it is necessary to apply some type of quality adjustment to the price comparison. Quality adjustment is dealt with in depth in Chapter 6.

([12]) Report from the Commission to the Council on Harmonisation of Consumer Price Indices in the European Union, (COM(2000) 742 final, 21.11.2000, Section 6.4.4.

Replacements as described above can occur at any time of year. They may be forced, due to the disappearance of a specific product offer, or they can be planned, i.e. a new product model has appeared on the market which has become representative of current consumer purchases, as such the existing product-offer which is no longer representative is replaced by the new one to keep the sample representative (see Chapters 4 and 5).

Additionally, in the December of each year, the complete basket of products should be resampled i.e. the representativity of the existing products should be reviewed to determine as to whether they are still representative. New more representative products may be added and products that are no longer representative should be removed from the basket. Annual resampling keeps the basket representative of consumer expenditure (see Chapter 3 — Weights and Chapter 4 — Sampling).

2.2.2 Comparability

A key requirement for national HICPs is that they be comparable. This means that differences in the national HICPs should reflect only differences in price changes or expenditure patterns and not be the result of differences in methods.

The aim is comparability of results. That means that different countries would produce the same results from the same data set of prices and weights. Where prices develop differently or the consumption pattern is different (i.e. the weights are different), HICPs will naturally differ.

Where results differ due to differences in concepts, methodology or compilation practices, the aim of the HICP is to eliminate these through harmonisation. However, the principle of subsidiarity means Member States are allowed to use methodologies which best reflect their national circumstances on condition that the results can be demonstrated to be comparable.

The comparability threshold for deviation in average annual change of HICPs is defined to be one part per thousand (one tenth of a percentage point) at the all-items level (see Article 4(2) of Regulation No 2016/792).

The implementing regulations set out a number of specific detailed methods which Member States must apply when compiling an HICP; for example, Regulation No 330/2009 applies to seasonal products. This manual sets out examples of preferred methodologies or good practice in many areas of the HICP. These go beyond the legal requirements of the regulations and are as such only advisory in nature.

2.3 Scope and coverage

2.3.1 Household final monetary consumption expenditure

In general, the concepts, definitions and conventions adopted in the HICP are as far as possible consistent with those used in the global framework for national accounts (the United Nations System of National Accounts (SNA 2008)), and its European Union version, the European System of Accounts (ESA 2010).

Among these concepts is that of household final consumption expenditure. A subset or derivation of household final consumption expenditure is household final monetary consumption expenditure; this refers to that part of household final consumption expenditure that occurs in monetary transactions only. Household final monetary consumption expenditure is thus a narrower concept than household final consumption expenditure, which includes both non-monetary and imputed transactions. Household final monetary consumption expenditure is a fundamental concept of the HICP. It defines the *scope* of the HICP. *Coverage*, although related to the concept of scope, is more associated with how much of what is defined by the scope is actually covered, i.e. the coverage of the HICP is that part of Household Final Monetary Consumption Expenditure which is actually included in the HICP.

Article 2(20) of Regulation No 2016/792 defines household final monetary consumption expenditure in accordance with ESA 2010:

'*Household final monetary consumption expenditure means that part of final consumption expenditure incurred:*

I.   *by households,*
II. *in monetary transactions,*
III. *on the economic territory of the Member State*
IV. *on products that are used for the direct satisfaction of individual needs or wants, as defined in Annex A paragraph 3.101 of ESA 2010,*
V.   *in one or both of the time periods being compared.*'

The HICP is a *consumer* price index, that is, it covers the expenditure of the household sector, but not that of other sectors of the economy such as the government and business.

The definition of households is provided in ESA 2010 (Annex A, paragraph 2.118):

'*Households as consumers may be defined as small groups of persons who share the same living accommodation, who pool their income and wealth and who consume certain types of goods and services collectively, mainly housing and food.*'

Paragraphs 2.119 (a) and (b) of Annex A further define the household sector as:

(a) '*Individuals or groups of individuals whose principal function is consumption;*

(b) *Persons living permanently in institutions who have little or no autonomy of action or decision in economic matters (e.g. members of religious orders living in monasteries, long-term patients in hospitals, prisoners serving long sentences, old persons living permanently in retirement homes). Such people are treated as a single institutional unit: a single household.*'

As defined above, households can range from a person living alone to a large collection of individuals living in a group, e.g. individuals living in institutions such as retirement homes. In the latter case, only residents' private expenditure is covered. The expenditure of the institution itself, for example on food or nursing services, is excluded. All fees paid to the institution by residents fall within the scope of the HICP.

Business expenditure, including business expenditure incurred by household members, falls outside the scope of the HICP.

According to Regulation No 1749/96 concerning geographic and population coverage:

'*HICPs compiled using sub-index weights which reflect final monetary consumption expenditure of a sub-set of households, rather than all households, shall be deemed comparable, where this difference in practice accounts for less than one part per thousand of the total expenditure covered by the HICP.*'

This may be the case where Household Budget Survey data are used as the primary data source for sub-index weights because detailed national accounts data is unavailable at that level. In order to be comparable, the weights need to be adjusted using other data sources to ensure that the difference accounts for less than one part per thousand of the total expenditure covered by the HICP.

All households, irrespective of nationality or residence status, are covered by the HICP (see Section 2.3.2 — The domestic concept).

The economic territory of a Member State is defined in Regulation No 2016/792 Article 2(19):

'*economic territory means the territory as defined in Annex A, paragraph 2.05 of ESA 2010, with the exception that the extraterritorial enclaves situated within the boundaries of the country are included and the territorial enclaves situated in the rest of the world are excluded.*'

In household final monetary consumption expenditure, *final* is a technical term used in national accounting conventions, which refers to goods and services used up by individual households to satisfy their individual needs or wants.

Monetary is the key word in household final monetary consumption expenditure. It means that to qualify as a transaction for inclusion in the HICP, money must change hands. Naturally, this does not refer only to cash, but to any kind of money, including electronic transfers or purchases made using credit. Imputed transactions, own production and bartering are excluded.

Examples of non-monetary transactions that are excluded from the HICP include the following:

- Own production covers goods that are produced by households, such as food produced on small farms for their own consumption. There are no prices to be observed since there are no sales transactions, so prices would have to be imputed. Own production is excluded from the HICP.

- Households can also incur non-monetary expenditure when employees acquire goods and services from their employers as remuneration in kind. This can be seen from a conceptual viewpoint as a household paying in labour (as an employee) rather than cash. Consumption stemming from income in kind is also excluded from the HICP. Examples include free or subsidised housing, meals, free use of company cars for private use, etc.

Owner-occupied housing costs pose a particular challenge. Some national CPIs include a proxy for the cost of shelter by owner-occupation in the form of estimates of the rent which would be payable if the property was rented rather than owned. This is known as imputed rent or rental equivalence. This is not permitted in the HICP on conceptual grounds, as there are no actual transactions and no money changes hands. Imputed rents are outside the scope of household final monetary consumption expenditure. A measure of owner-occupied housing cost using the net acquisition approach would meet the requirement of being based on actual monetary transactions. An owner-occupied housing price index according to this approach has been developed as a stand-alone index in the EU. No decision on including it in the HICP has yet been taken ([13]).

The phrase *in one or both of the time periods being compared* reflects the fact that HICPs are sample statistics that represent the change in prices, on average over the target 'universe' of prices, between two specified periods of time. While expenditure on a certain product can occur either in the first period or the second, or in both periods, for a price index to be calculated, the price must be recorded in both periods. Exceptions are prices which change from zero to positive and vice versa (see Section 7.5).

The final key term in the expression household final monetary consumption expenditure is *consumption expenditure*. This is expenditure on consumption products by the household sector. It therefore excludes all capital expenditure, such as the purchase of land or financial assets like stocks and shares.

Interest payments, especially interest on mortgages for house purchases but also interest on other types of loan, or lost potential interest on paid-up capital, are likewise excluded from the definition of household final monetary consumption expenditure even though they are monetary transactions. They are classified as distributive transactions, not consumption, in the European System of Accounts ESA 2010. Social transfers received by households can be in kind or in cash. A transfer in kind is defined as a transaction in which one unit provides a good, service or asset to another without receiving any good, service or asset in return (see ESA 4.108). A transfer is outside the scope of household final monetary consumption expenditure since the household acquires no good or service; a social transfer may contribute to a household's welfare or standard of living but, by definition, no price can be observed. The price for a household receiving a social transfer is normally zero and goods or services provided free carry no weight in the HICP. See Regulation No 1749/96, Annex 1b paragraph 12.

Examples of social transfers in kind include:

- education,

- health,

- kindergarten and other social protection services,

- housing.

Social transfers in kind do not include collective services provided by the government to the community as a whole, such as public administration and defence.

([13]) Regulation (EU) No 2016/792 requires that, by 31 December 2018, the Commission provide a report to the European Parliament and the Council on the suitability of the owner-occupied housing price index for inclusion in the HICP.

In some Member States households pay a charge for these kinds of services rendered by government or non-profit organisations. This payment is regarded as consumption and should be taken into account in the HICP. If government or non-profit institutions serving households introduce a charge and the price changes from zero to a positive value this change should be captured in the HICP (see Sections 7.5, 12.1 and 12.4). Household final monetary consumption expenditure does cover goods and services provided to households at low non-market prices.

Reimbursements, expenditure initially made by households for which they are subsequently reimbursed by social security, government units or non-profit institutions serving households, are also classified as transfers. When purchasing a good or service that is subsequently reimbursed in part or in whole, the household is treated as an agent acting on behalf of a social security fund, government unit or non-profit institution serving households. The amount being reimbursed is treated as a social transfer in kind and not as a cash transfer to households, and does not form part of a household's disposable income. This means that the price used for the HICP is the amount paid by the household less the reimbursement.

Transfers in cash are money received by the household; it is regarded as part of the disposable income of the household and therefore not covered by the HICP. Households will subsequently spend this income, and expenditure financed by these transfers falls within the scope of the HICP.

All *other rebates by public authorities*, especially housing payments to tenants in order to reduce their rents (including payments which at the tenant's discretion go directly to the landlord), are considered social benefits in cash and so contribute to the household's disposable income. When households pay for goods or services from their disposable income, the full price of the good or service before the rebate is to be included in the HICP.

Gifts, subscriptions, tips and gratuities, and transfers paid: gifts are not a part of household final monetary consumption expenditure since they are defined as transfers. Subscriptions or contributions to non-profit institutions serving households like trade unions, professional societies, consumers' associations, charitable organisations, churches and social, cultural, recreational and sports clubs are not covered if no identifiable services are received in return. However, if a club, union, society or association can be considered a market producer selling its services at an economically significant price, then subscription contributions and dues paid to it by households are considered to be not a transfer but a payment for the services, which is thus covered by the HICP. Non-compulsory tips or gratuities for services rendered are outside the scope of household final monetary consumption expenditure. They are also to be regarded as transfers. In some cases, even though tips are not compulsory, it can be difficult to obtain a good or a service without some form of additional payment. In such cases, tips are included in household final consumption expenditure as a part of the purchaser price of goods and services.

Compulsory or voluntary social contributions, such as employers' actual social contributions to social security funds, public health insurance or other insurance companies are not covered in household final monetary consumption expenditure, as social contributions are treated as transfers and are thus not included in final consumption.

Fines and penalties are excluded from final monetary expenditure. They are imposed by institutional units like courts of law or other institutions and are treated as compulsory current transfers.

Licences: payments by households for licences to own or use certain goods or facilities are classified as consumption expenditure and not as transfers if they constitute payment for a *specific service*. Licences to own or use vehicles, boats or aircraft and for hunting, shooting and fishing are treated as direct taxes since no specific, individual good or service is received in return for the payment. However, tolls (turnpike money) for the use of roads, bridges and tunnels are consumption expenditure and are included in the HICP, as they are payments for a specific service. Due to ambiguities in whether licences are taxes or service charges, a number of conventions have been developed. These are listed in the International Monetary Fund's (IMF) Government Finance Statistics Manual 2014 (Section 5.72) and have also been adopted in the ESA.

Second-hand goods are included if not bought from another household. In many Member States a market for second-hand (used) goods exists. Households may buy second-hand goods through different channels:

- directly from another household, or
- directly from another sector, e.g. from an enterprise or from abroad, or
- from an enterprise or from abroad through an importer.

The weights for second-hand goods are based on households' net expenditure; total purchases less sales. All current transfers in cash between households (both residents and non-residents) are not part of final monetary consumption expenditure. This means that buying or selling second-hand goods from or to another household within the same economic territory is not recorded, since net expenditure will be zero.

The purchase of second-hand goods from another sector (an enterprise or from abroad) will be a part of household final monetary consumption expenditure. The appropriate expenditure to be covered in the HICP will be households' purchases of the goods less sales to other sectors. For example, for second-hand cars, if the transaction involves a dealer (either through purchase within the household sector or from an enterprise, or from abroad), the fee for the service provided by the dealer is part of consumption expenditure (see Chapter 3).

2.3.2 The domestic concept

The geographic coverage used in the HICP is the *domestic concept*. This takes into account all household final monetary consumption expenditure within the economic territory of a Member State, whether made by resident or non-resident households. The economic territory is defined in Section 2.3.1. Consumption expenditure incurred by residents when they are outside the Member State of residence is excluded from the HICP (see also Section 7.2 for cross-border internet purchases), while expenditure incurred by visitors from other countries (e.g. tourists and expatriates visiting home) is included.

Bearing in mind the principal use of the HICP as an indicator for monetary policy purposes, there are two main reasons for using the domestic concept for the coverage of the HICP:

1. By confining expenditure to that incurred within an economic territory, the resulting HICPs cover only those price changes which national/euro area monetary policies can directly influence.

2. Consistent aggregation of national HICPs if a European aggregate HICP (e.g. for the euro area) is compared with another country or economic bloc, it must be certain to represent the whole of consumer price inflation within the euro area and none of it must be double-counted.

Using the domestic concept ensures that these conditions are met.

An alternative to the domestic concept is the *resident concept*, where all expenditure incurred by residents of a country (whether nationals or non-nationals) is measured, regardless of whether it is incurred inside or outside the economic territory. Under the resident concept, expenditure within the economic territory incurred by non-residents such as tourists is excluded.

Note that, on the production side, GDP uses the domestic concept (gross *domestic* product). In contrast, household final monetary consumption expenditure, which is based on the expenditure approach, uses the resident concept. This means that to be able to use household final monetary consumption expenditure data to estimate HICP weights, an adjustment is required to exclude residents' expenditure abroad and to include non-residents' expenditures within the economic territory.

Additionally, it should also be noted that both the domestic and resident concepts at global (world) level would produce the same results in terms of aggregate expenditure. However, at the EU and euro area levels they would not, due to the expenditure of EU/euro area residents outside Europe, and the expenditure of non-EU residents within Europe. In practical terms, this makes the domestic concept in some ways the easier one to implement, as the resident concept would require detailed information on residents' expenditure and prices paid outside the economic territory.

2.3.3 Product coverage

It is essential that the HICP is based on a clear and unequivocal classification system for consumption products and that the same classification is used by all EU countries. It was decided to adopt the Classification of Individual Consumption According to Purpose (COICOP) developed by the United Nations. This classification divides the basket of goods and services into divisions (2-digit), groups (3-digit) and classes (4-digit). Further work in the EU has resulted in a refinement of COICOP to incorporate an additional level of (5-digit) sub-classes. The version used in the HICP is known as the ECOICOP; the full ECOICOP classification is given in Annex I. ECOICOP is the version of COICOP used in all EU economic statistics covering consumer expenditure (the national accounts, purchasing power parities,

household budget surveys and the HICP). For each specific use, certain categories may be omitted — for example, non-monetary transactions such as imputed rents (see below) are omitted from the HICP.

It should be noted that even though ECOICOP extends to 5 digits (that is, 4 levels of classification excluding the single all-items level), each Member State must usually extend the classification to a more detailed level (see Chapter 3). This lower level is generally not for publication but is required because elementary product groups and elementary aggregates are commonly defined well below the level of ECOICOP 5-digit sub-classes (see Chapters 3 and 4). It is at this level that products are sampled, which in turn determines the structure of price collection. The elementary aggregates represent the building blocks of the HICP from which the ECOICOP aggregates are calculated. Only those price indices and weights at the 5-digit sub-class level and above are normally required to be transmitted to Eurostat each month.

Some categories of consumption expenditure are excluded either in principle or on practical grounds from HICP coverage. These are (with ECOICOP categories):

02.3	Narcotics
04.2	Imputed rentals for housing
09.4.3	Games of chance
12.2	Prostitution
12.5.1	Life insurance
12.5.3.1	Public insurance connected with health
12.6.1	Financial intermediation services indirectly measured (FISIM).

Narcotics (02.3) and prostitution (12.2) are included in principle in household final monetary consumption expenditure, but are not covered in the HICP for practical reasons. Price collection was deemed too problematic in these areas. Whether the purchase of a good or service is legal or illegal in a country is not relevant for its treatment. They are included in GDP and are also included in private consumption expenditure.

Games of chance (09.4.3) fall within the scope of household final monetary consumption expenditure according to the ESA and the Framework Regulation. However, they are currently (in 2017) excluded from the HICP on the grounds that no harmonised method for their treatment has yet been agreed upon.

For owner-occupiers, national accounts assume that dwellings provide a stream of capital services, which represent an input into the production of housing services. So owner-occupiers may be considered to consume the housing services produced as outputs from this production. In household final consumption expenditure, these services are included by way of imputed rentals (04.2). As these costs are imputed and are not monetary transactions, imputed owner-occupier housing costs are not part of household final monetary consumption expenditure and are not within the scope of the HICP.

The HICP also excludes financial intermediation services indirectly measured (FISIM) (12.6.1), i.e. those parts of financial services where the implicit charge involved is the net interest earned by financial institutions. No explicit (monetary) charge can be identified for the intermediation services that financial institutions provide to their customers. As an imputed (non-monetary) transaction, financial intermediation services indirectly measured are excluded from the HICP. Note that financial services that attract explicit charges, for example annual charges for credit cards (excluding interest charges), bank charges for money transfers, and currency exchange commissions etc., are included in the HICP — see Section 12.8.

As a rule, the scope of the HICP includes the prices of all goods and services included in household final monetary consumption expenditure. *Non-consumption* expenditure, such as financial transactions, transfers and purchases of financial assets, is excluded. According to ESA 2010, all insurance services are within the scope of household final monetary consumption expenditure, and are to be included by the amount of the implicit service charge. However, life insurance is excluded from HICP coverage. Premiums paid for life insurance (12.5.1), including pension-funding services, are regarded as savings and so are not part of the HICP. Life insurance is excluded because it is not possible to separate out the implicit service charge for the insurance component from the implicit service charge for the investment component. Non-life insurance services are, however, included in the HICP. Public insurance connected with health (12.5.3.1) falls outside the scope of the HICP because compulsory contributions under social security schemes are not included in household final monetary consumption expenditure.

2.3.4   Product coverage: special cases

A small number of important product types pose special measurement problems. These are dealt with individually in implementing regulations. They are as follows:

- *Non-life insurance (see Section 12.2)* (Regulation No 1617/1999). These include: motor vehicle, travel, dwelling [14] (contents only) and private medical insurance, pet insurance, etc. The bulk of total premiums paid by policyholders is paid out to claimants. There is therefore no net expenditure by the household sector as a whole, except to cover the service charges (costs and margins) of the insurance companies. This is dealt with in the HICP, in principle, by covering only the insurance companies' service charges. This can be done without much difficulty as far as weights are concerned, but measuring the price of a service charge is generally not possible. So the price is assumed to follow the same trend as the price of the gross premium.

- *Tariff prices (see Section 7.4)* (Regulation No 2646/98). Measuring the average price changes of products listed within a tariff (e.g. a list of rail fares taking account of the day of the week, time of day, type of passenger, etc.) may pose some difficulties. The Regulation lays down a set of rules on how tariff prices should be treated in the HICP.

- *Proportional service charges (see Section 7.3)* (Regulation No 1920/2001). Some service charges, such as those charged by stockbrokers, are charged as a proportion of the amount of the relevant transaction. The representative transaction takes account not only of any change in the proportional rate of the charge but also the value of the transaction, as updated by the change in an appropriate price index over the same period.

- *Prices dependent on purchasers' income or other socioeconomic characteristics (see Section 12.1).* Some prices are dependent on or linked to such factors as household income or the number or age of children. Changes in purchaser prices resulting from changes in purchasers' incomes are to be shown as price changes in the HICP.

- *Seasonal products (see Section 7.1)* (Regulation No 330/2009). The non-availability of certain types of product during parts of the year poses problems for index calculation. These products are usually related to the seasons, often because certain types of fresh product or clothing are available only during a particular season. These products should also be included in index calculation. The Regulation sets out methods of dealing with seasonal non-availability of products.

2.4   Index type (see Chapter 8)

The HICP uses different formulas for aggregating prices and price indices, depending on whether or not the products concerned have weights attached to them. In general, products within an elementary aggregate index are unweighted, while at the level of the elementary aggregate index and above weights are available. At those levels, the HICP uses a Laspeyres-type formula.

The HICP is a Laspeyres-type index obtained by annually chain-linking 13-month (December to December) indices — see Chapter 8. December of each year is the *overlap or link month* in which the new and old basket of products are priced. A numerical example of chain-linking is given in Chapter 8.

In the HICP the weight reference period is a year and the price reference period is a month (December of each year). Weights at all levels of the ECOICOP must be updated each year (see Section 2.6 below and Chapter 3). It should also be noted that the basket is strictly fixed only at the level of elementary aggregates (the lowest level where expenditure weights are generally available) and above. Below this level, product offers are continually being replaced to reflect market changes.

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[14] Dwellings insurance (covering the physical building) is one of the indices required to estimate owner-occupied housing costs in accordance with the net acquisitions approach.

2.5 Price concept (see Chapter 5)

The prices used in the HICP should be purchaser prices, which are the prices actually paid by households. Purchaser prices also include all unavoidable additional costs such as booking and delivery charges, which are typically associated with internet purchases — see Section 7.2 However, it is not always possible to observe the actual transaction price; so in practice it is usual to record the offer price or shelf price.

Product-related taxes such as VAT and other sales taxes and excise duties are included and any subsidies deducted. Discounts such as sales prices should be taken into account according to a set of criteria (see Chapter 5 — Price collection). Interest payments or service charges added under credit arrangements, and any extra charges incurred as a result of failing to pay within the period specified at the time of purchase, are disregarded.

The HICP follows the acquisition approach to the recording of prices. In this approach, acquisition is deemed to take place when the purchaser incurs a liability to the seller. In practical terms, for goods it is generally assumed that they are consumed at the time they are purchased, so prices for goods enter the HICP in the month that they are observed. However, many services (flights, package holidays, etc.) are either purchased in advance of when they are consumed, or they are consumed over a period of time (e.g. season tickets for transport and sporting services). The prices of services are therefore recorded in the HICP in the first month that consumption of the service can commence — see Regulation No 2601/2000.

2.6 Weights (see Chapter 3)

The overall inflation rate in a country, as measured by the HICP, is calculated in stages from the price changes measured at the most detailed level, product offers, which are aggregated up to the all-items (all-products) level. Section 2.2.1 referred to two levels of aggregation. Level I involves aggregation within the ECOICOP classification, starting at the 5-digit sub-class level. Level II aggregation occurs below this level, and starts with elementary aggregates; this is the lowest level at which expenditure weights are generally available. Within elementary aggregates, expenditure weights are generally unavailable. (See Chapters 3 and 8.) Without weights, a meaningful HICP cannot be calculated, since there would be no differentiation between expenditure on different categories of products, each with their particular rates of price change. It is very important, therefore, to be able to determine sufficiently accurate weights for all groups of products at the level of elementary aggregate and above. These higher groupings are always related directly to one or more categories in the ECOICOP classification.

Article 3(10) of Regulation No 2016/792, in conjunction with Article 3(2) of Regulation No 1114/2010 concerning HICP weights, requires HICP weights for published sub-indices (ECOICOP 5-digit sub-classes and above) to be reviewed every year. The weights ideally relate to estimated expenditure in the previous year and take account of preliminary national accounts data on household final monetary consumption expenditure. For elementary product group and elementary aggregate indices, i.e. level II described above, the requirement is that the weights should be no more than 7 years old. This reflects the maximum 5-yearly cycle of household budget surveys, with 2 years added for analysis of the most recent survey. Member States must also carry out an annual review of elementary product group and elementary aggregate weights to determine if there have been any important and sustained market developments, for example the emergence of newly significant products, and adjust the weights if necessary (see Chapter 3).

For the HICP, the aim is to use the best estimates of weights that can be obtained, regardless of the source. This follows from Article 3(1) of Regulation No 1114/2010, which requires that:

'Member States shall produce HICPs using sub-index weights which reflect the consumers' expenditure pattern in the weighting reference period and aim to be as representative as possible for consumers' expenditure patterns in the previous calendar year.'

Other data sources such as administrative data, retail sales, market research data, and data derived from scanner data can also be used to estimate weights at the most detailed product level.

2.7 Sampling and representativity (see Chapter 4)

Every day billions of consumer transactions take place in outlets throughout the EU. These involve purchases of millions of different products. In practice, it is not possible to record all consumer transactions. Therefore the construction of CPIs has always relied on sampling — and so does the HICP. Not only do products (goods and services) have to be sampled, so do the outlets where transactions take place.

The HICP is a sample statistic that represents the change in prices, on average over the target universe, between two specific periods. Given the differences in the national markets and populations of the EU Member States it would not be possible to impose a uniform sampling structure across all countries. Nevertheless, certain minimum standards must be followed. Article 6 of Regulation No 1749/96 requires Member States to ensure that:

- each ECOICOP category contains a sufficient number of elementary aggregates to represent the diversity of products within the category;

- the number of product offers (prices) recorded within each elementary aggregate is sufficient to represent the price movements in the population;

- all product categories that form a significant part of total consumption expenditure (at least one part per thousand) are covered in the sample.

The sample must be designed in such a way as to ensure that it is representative of all transactions: the result is a *target sample* which must be maintained so as to ensure that it remains valid in the face of continual market changes.

Sampling in the HICP is discussed in depth in Chapter 4.

2.8 Frequency

The HICP is a monthly statistic. It has to be compiled every month. This means that in principle prices have to be collected at least once a month. Less frequent price collection for some goods or services may be justified, if it is known that prices do not change from one month to the next and all price changes are sure to be captured by the index.

While HICPs are produced and published every month, their corresponding weights are reviewed and updated every year. The weights of a new year refer to $t-1$ (expressed in prices of the December of the preceding year). At the same time, the HICP country weights used in EU aggregates are also updated.

2.9 Methodological changes and revisions (see Chapter 10)

HICPs are in principle revisable, but only in limited circumstances. In general, revisions have to be made if errors are discovered after initial publication, and may also be made if the HICP is published as provisional and if new or improved basic information becomes available that is needed to improve its accuracy. Chapter 10 discusses how to handle methodological changes and revisions.

3

Weights in the HICP

3.1 Introduction

Calculating the HICP is a two-stage process. The first stage consists of computing price indices for each of the elementary aggregates (i.e. the elementary price indices) within the classification structure. The second stage involves arranging these elementary price indices into a number of higher-level indices up to and including the all-items HICP. Aggregating through to the all-items level is accomplished by taking weighted averages of the lower-level indices, where the individual weight for each of these indices is equal to the expenditure share for the corresponding good or service. More precisely, this second stage consists in computing an arithmetically weighted average of the price changes of the elementary indices as defined by a Laspeyres-type price index formula. The weights in the HICP exist to properly account for the effect of price changes on the inflation experiences of the households it is meant to cover, thus providing feedback as to which price change for the many items in the basket will have the greatest (or least) impact on the overall HICP.

The data used for constructing the weights of the HICP are derived from various sources, national accounts data being the primary source since their use for determining the weights in the HICP (at given levels of aggregation) is mandated by regulation. Additionally, national accounts data have the virtue of being structured and organised according to the European classification of individual consumption according to purpose (ECOICOP) classification regime as well as following an annual updating cycle, both essential features of the HICP. Other sources of information for estimating weights in the HICP, though typically for lower levels of aggregation, are household budget survey (HBS) data, market intelligence information, retail trade data, various administrative sources and more recently scanner data.

This chapter elaborates on the role of weights in the compilation of the HICP and describes how they are estimated before they are actually applied in the compilation of the HICP.

The rules for the estimation of weights for the HICP comprise certain important and distinctive features. For instance, it is often recommended in CPI literature that the basket be updated as frequently as possible — at least every 5 years. EU regulations are more prescriptive, and state that the basket and its weights (at least starting at the ECOICOP 5-digit level) must be updated annually; moreover, the link period for the new basket including its new weights scheme, again according to the HICP framework, is fixed as the month of December. Additionally, the weights at the ECOICOP 5-digit level and above should generally be based on household final monetary consumption expenditure data derived from the national accounts.

This chapter discusses the sources of information and the derivation of the expenditure weights to be used in the HICP. More specific topics are also covered including data sources and derivation of weights for second-hand motor vehicles, etc. For additional and more specific discussions on methodological and conceptual issues related to the topic of weights, consult Chapter 4 of The Practical Guide to Producing Consumer Price Indices (2009) and Chapter 4 of The ILO Consumer Price Index Manual: Theory and Practice (2004).

3.2 Legal framework, definitions and terminology

3.2.1 Legal framework

The legal framework provides the minimum standards for producing the weights in the HICP. The issue of weights is covered in the following articles of the HICP Framework Regulation and Implementing Regulation.

The Framework Regulation

Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95

'Article 3 — Compilation of the harmonised indices

10. Each year, Member States shall update sub-index weights for the harmonised indices. The Commission shall adopt implementing acts specifying uniform conditions for the quality of weights of the harmonised indices. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 11(2).'

The Implementing Regulation

Commission Regulation (EC) No 1114/2010 of 1 December 2010 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the quality of HICP weightings and repealing Commission Regulation (EC) No 2454/97 ([15])

'Article 1 — Subject matter

The aim of this Regulation is to establish minimum standards for the quality of HICP weightings of the Harmonised Indices of Consumer Prices (HICPs).

Article 2 — Definitions

For the purpose of this Regulation the following definitions shall apply:

> *1.   the 'weighting reference period' of an HICP means the 12-month period of consumption or expenditure from which the weights are estimated for the compilation of the HICP index figures.*

> *2.   'sub-indices' mean the sub-indices laid down in Commission Regulation (EC) No 2214/96 of 20 November 1996 concerning harmonised indices of consumer prices: transmission and dissemination of sub-indices of the HICP.*

Article 3 — Minimum standards for HICP weightings

1. Each month, in current year t, Member States shall produce HICPs using sub-index weights which reflect the consumers' expenditure pattern in the weighting reference period and aim to be as representative as possible for consumers' expenditure patterns in the previous calendar year.

2. Each year, Member States shall therefore review and update HICP sub-index weights taking into account preliminary national accounts data on consumption patterns of year t–2, except in exceptional and in duly motivated circumstances, as well as any available and relevant information from household budget surveys and other data sources which are sufficiently reliable for the purposes of the HICP.

3. As regards weights below sub-index level, including those for Elementary Product Groups as defined in Regulation (EC) No 1749/96, Member States shall use weights which are in no case more than seven years old.

4. Member States shall review annually whether or not there have been any important and sustained market developments affecting quantities in the sub-divisions of COICOP/HICP, between the periods as described in paragraph 2 and 3 and period t–1, in order to estimate weights that are as up-to-date as possible. Especially, consumption expenditure for sub-divisions of COICOP/HICP with known changes following administrative decisions and for products in fast evolving markets shall be reviewed.

5. Any adjustments made to weightings pursuant to this article shall take effect with the index for January of year t. HICP weights for previous years shall be not revised, without prejudice to the possibility to correct mistakes in accordance with Article 4 of Commission Regulation (EC) No 1921/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for revisions of the HICP and amending Regulation (EC) No 2602/2000. In any case, HICP weights shall take effect with the index for January each year and be price-updated to prices of the preceding December.

Article 4 — Quality control

Member States shall provide the Commission (Eurostat) at its request with sufficient information on the weights used to construct the HICP, including the weighting reference period used, the outcome of the annual review and the adjustments made, for compliance with this Regulation to be evaluated.'

([15])   OJ L 316, 2.12.2010. p. 4.

3.2.2   Definitions and terminology

Regulation (EC) No 1749/96, initial implementing measures**,** gives the following definitions relevant to HICP weights:

'Article 2 — Definitions

13. *An 'elementary product group' means a set of product-offers that are sampled in order to represent one or more consumption segments in the HICP.*

14. *An 'elementary aggregate' means an elementary product group stratified by, for instance regions, cities or outlet types and thus refers to the level at which observed prices enter the HICP. Where elementary product groups are not stratified, the terms 'elementary product group and 'elementary aggregate' have the same meaning.'*

Below are some additional definitions and terminologies related to weights, which are not set out in the Regulations:

Coverage: Is the statistical *target universe* to be represented by the HICP.

Expenditure (or weight) share: The expenditure share represents each product's relative importance in the fixed basket, regardless of its level in the aggregation structure. In the HICP, the weight share is the proportion of total expenditure on all goods and services covered by the index. It is usually expressed as a percentage of total household monetary consumption expenditures that will sum to 100 or in parts per 1 000 that sum to 1 000.

Price-updating of the weights: A procedure where expenditure in the weight reference period is is revalued at the prices of a later period which is also known as the price reference period. This procedure is applied at the sub-index level of the HICP in order to take into account the relative price changes which have occurred between the weight reference period and the price reference period.

Laspeyres-type price index: An index that measures the average change in prices from a price reference period to a comparison period using expenditure shares from some period prior to the price reference period, and where the expenditure shares are adjusted to reflect the prices of the price reference period (see Chapter 8).

3.2.3   HICP weights: What the weights Regulation requires

The Regulation requires that HICP weights at all levels of ECOICOP are updated every year: In practice this means that compilers should estimate new sub-index weights using the latest available data from the national accounts (normally preliminary estimates relating to the calendar year *t*–2). These data are a subset of household final monetary consumption expenditure that includes non-resident expenditure within the economic territory and excludes residents' expenditure abroad in accordance with the domestic concept (see Chapter 2). In most countries, this should be possible down to the 4-digit class level. If this detailed expenditure is not available, then other data sources (normally the household budget survey) can be used to subdivide the higher-level ECOICOP expenditures derived from the national accounts to estimate 4-digit class and 5-digit sub-class weights. Other data sources such as retail sales data and data from administrative sources can also be used so long as they are sufficiently reliable. The Regulation also requires the weights to be updated in order to include newly significant goods and services, and to adjust weights accordingly where known changes in expenditure have occurred (e.g. some types of administered prices).

Weights should relate to a 12-month period: Annual data are required because averaging data over longer periods has the potential to smooth out real changes in expenditure patterns, which may be detrimental to the relevance of the HICP. For example, rapid and large changes in fuel prices can significantly impact HICP weights. Generally, the only exceptions are the weights for insurance services, where three years of data should be used. This exception was made to insure against the possibility of obtaining negative insurance weights, which could occur if, in a given year, a major disaster leads to claims and insurance pay outs exceeding revenues from premiums during that year. (See Section 12.2) [16].

Below the sub-index level including those for elementary product groups, elementary aggregates, weights should be no more than seven years old: Weights at these levels are normally derived from the household budget survey and

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[16]   Changes resulting from the implementation of ESA 2010 should prevent weights from being negative. However, there are circumstances in which this can still occur (see Section 12.2), so this requirement is still valid.

other sources (e.g. retail sales data). As some countries only conduct household budget surveys every 5 years, the Regulation allows these lower-level weights to be updated less frequently but also ensures that they are no older than 7 years, thus allowing Member States time to process and incorporate the latest household budget survey data in the HICP.

New weights are to be estimated for December of each year: However, weights are price-updated to the December of each year (price reference period), and take effect with the index for January of the following year (see Chapter 8 — Index calculation).

Weights should not be revised unless a mistake is found: For the purposes of the HICP, mistake is defined in Chapter 10. As noted above, HICP sub-index weights are estimated annually from preliminary national accounts estimates. Subsequently, national accounts estimates are frequently revised; such revisions do not constitute a mistake; accordingly, the weights should not be revised.

3.3 The structure, data sources and reference period for HICP weights

3.3.1 Weighting structure: Two levels of weights

The classification regime of the HICP can be divided into two levels.

- Level I comprises product groupings and their respective weights that reflect the ECOICOP classification.

- Level II (below the 5-digit level), by contrast, follows no pre-defined classification system. Individual countries decide how to organise this lower level, and it often depends on the detailed expenditure data available by product type, the sampling approach they use, and the resources available.

Regardless of how Level II is organised, elementary aggregates should be defined somewhere within that Level II structure. Elementary aggregates are the building blocks of the HICP.

Chart 3.1, at the end of this section, illustrates a possible stratification structure showing the two levels: Level I groupings of products down to and including the 5-digit sub-class level, and Level II entries below the 5-digit level for a specific example (nuts).

Below the all-items level, three examples are shown for the 2-digit division level: (1) Food and non-alcoholic beverages, (2) Alcoholic beverages and tobacco, and (3) Other divisions (the latter for completeness). At the next level, the 3-digit group, Food and non-alcoholic beverages, is then split into two distinct and separate groups of products: (1) Food, and (2) Non-alcoholic beverages. Moving down from Food, two examples of the 4-digit class level are shown (plus a catch-all 'Other classes'): (1) Fruit, and (2) Vegetables. Fruit is further divided into four corresponding 5-digit sub-classes: (1) Dried fruit and nuts, (2) Fresh or chilled fruit, (3) Preserved fruits and fruit-based products, and (4) Frozen fruit. The 5-digit ECOICOP marks the dividing line between Levels I and II.

Within the Level II area of the classification hierarchy, there is no common classification system which Member States must use. The only condition is that the elementary product groups/elementary aggregates must be constructed in such a way that they generate acceptable estimates for the corresponding 5-digit sub-class. The example given in Chart 3.1, moving down from the 5-digit sub-class Dried fruit and nuts (ECOICOP 01.1.6.3) illustrates the various relationships in the HICP structure. The chart splits it into two sub-sub-classes: (1) Nuts and (2) Dried fruit.

Moving down the hierarchical structure, the next level of aggregation is the elementary product group. In this example, the compiler has decided that three elementary product groups are needed: 1) Peanuts, 2) Almonds, and 3) All other nuts. These categories of products have been selected to represent price changes for the broadly defined product category called Nuts, which in effect could be identified as the consumption segment (see Section 4.2.2 for the definition of consumption segment).

The lowest level for which explicit weights are available is generally the elementary aggregate (EA) level. This particular example includes a number of elementary aggregates, one of them being 'Peanuts sold in supermarkets

in region A'. Thus, the elementary aggregate acts as a sampling frame, setting the boundaries for the nature of the prices to be collected in terms of product offers, i.e. price observations. If stratifying an elementary product group by outlet type and region is not an option, because of data limitations, then the elementary product group and the elementary aggregate become one and the same.

The three elementary product groups and their corresponding indices will produce an indicator of price changes for all peanuts from the universe of peanuts bought by consumers within the economic territory. Chart 3.1 includes an area at the bottom that shows the universe of peanuts from which the sample of peanuts for the HICP can be drawn.

To accurately estimate the elementary price indices that correspond to the various elementary aggregates for peanuts, a sample of product offers will be drawn, the prices of which will be used in calculating the index. To accomplish this objective, the concepts of the *Target sample* (TS) and *Product-offer* (PO) were developed so that compilers could sample the prices based on a common set of guidelines and procedures. Although the two concepts are not formally part of the classification system, they are included in Chart 3.1 to show how and where they fit into it. Chapter 4 covers sampling for the HICP in more detail.

Chart 3.1: Classification structure for the various levels of aggregation of an HICP
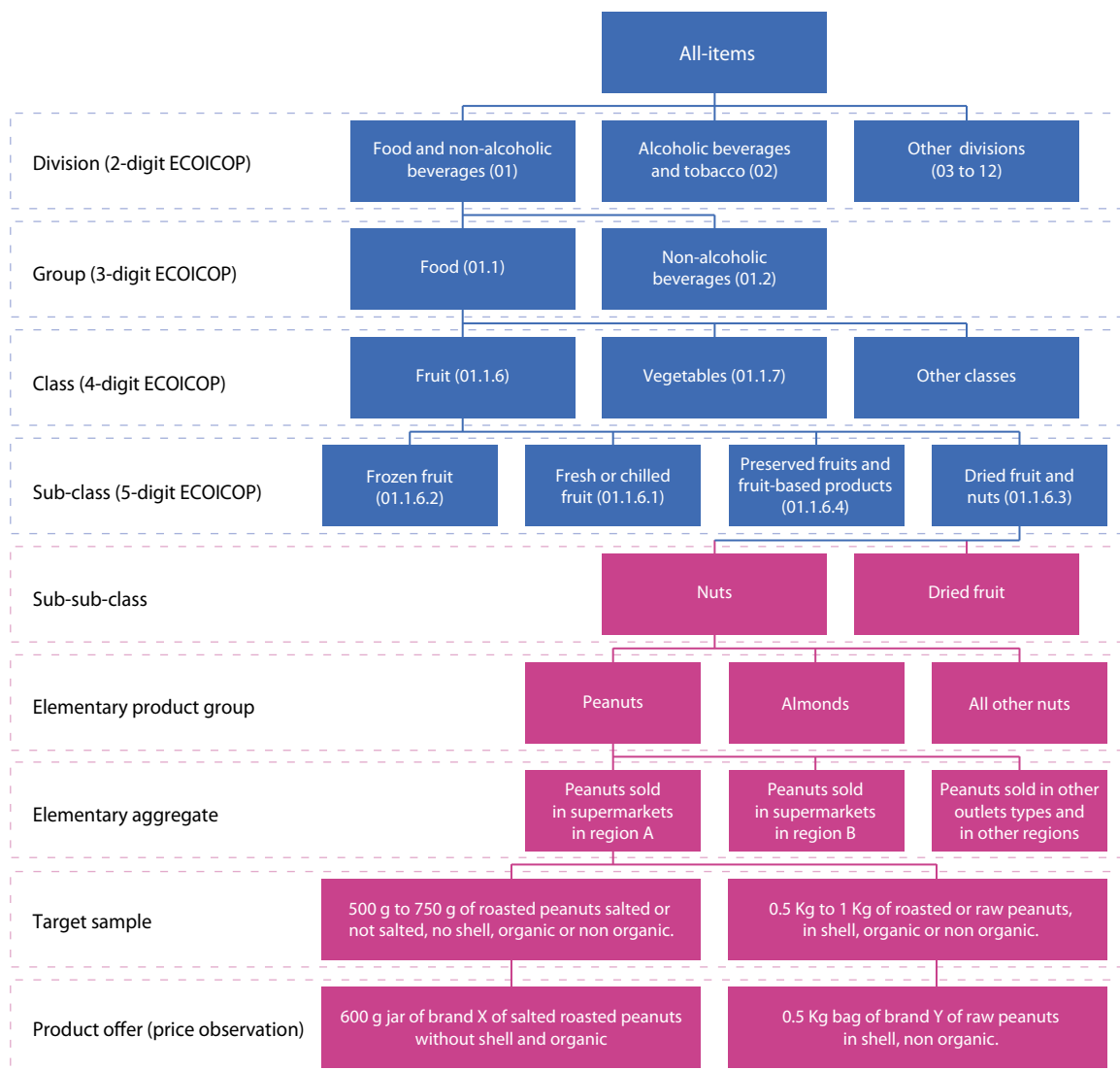
3.3.2   Weights by geographical breakdown

This section explains how the weights for geographical areas (e.g. breakdown by region and/or rural versus urban) can be estimated. To increase sampling efficiency and the quality of the price index, elementary product groups can be stratified by region. These weights can usually be obtained from the HBS, as the questionnaires will contain a geographical code for the location of the respondent. Note, however, that with these data, the respondent's location may differ from the location of some of their purchases. For instance, many households living in what is defined as a rural area may shop in urban areas when it is convenient for them. For practical purposes, however, this issue can be ignored without compromising the reliability and accuracy of the HICP.

In some countries, national accounts data are available by region (e.g. state or province) and this can be a realistic option for obtaining weights data by geographical area for the HICP. If either HBS or national accounts data are unavailable, then regional population counts, though less than ideal, may be the only realistic option available to compile regional weights.

3.3.3   Weights for outlet types

Another dimension of stratification is by type of outlet. This approach can be used to complement the stratification by region described above. Alternatively, if no regional breakdown is possible, then elementary product groups could be stratified by type of outlet alone. For example, in Chart 3.1, the elementary product group for peanuts is divided into elementary aggregates which are defined along the lines of outlets that are supermarkets and other outlet types, which could be, for example, speciality stores that sell mostly nut-based products.

Outlet type is perhaps the most important stratification variable, as both price levels and price changes can vary significantly among the various kinds of outlets that co-exist. The growth of national and international chain stores (which often engage in national pricing practices) in many countries has in some situations reduced the relevance of regional differences in prices (both levels and movements). Where independent stores are still significant in terms of where consumers choose to shop, it is important that elementary aggregates are appropriately weighted to reflect their relative importance for each elementary product group.

The source information for outlet types can usually be obtained from retail trade data for at least the broadest categories of products. Sometimes, the household budget survey may include sufficient information for the statistician to derive the outlet type from which the household made its purchases. Some countries have used other techniques for deriving outlet-based weights for constructing finer levels of detail for their elementary product groups, by either using a point-of-sales survey or scanner data or consulting their country's business register.

Purchases made over the internet are of growing importance. More and more consumers are buying online. In particular, some categories of products are well-known for being bought predominantly over the internet, e.g. books, music and package holidays. Ideally, at least for those products that are known to be mainly bought online, elementary product groups should be stratified to reflect this. Information for weighting the internet stratum can be drawn (if available) from market research companies, which closely monitor consumers' use of the internet for online shopping. Additionally, some HBS surveys now record information about outlet type (including internet purchases). This, along with the corresponding expenditure, is a potential data source for stratifying elementary product groups by outlet type.

3.3.4   Weights within the elementary aggregate

The price index of an elementary aggregate (the elementary index) is calculated directly from collected prices. The price indices are first calculated for goods and services that have been sampled or chosen because their price behaviour is considered characteristic of the elementary aggregate they were selected to represent. Typically, this will lead to prices within the elementary aggregate that have a similar pattern of change.

Unlike weights for the five levels of the ECOICOP, weights below sub-index level do not have to be updated annually. Under Article 3(3) of Regulation No 1114/2010, the data used to weight the elementary product groups or elementary aggregates must not be more than 7 years old. This recognises that some Member States only conduct household budget surveys at five-year intervals. While the household budget survey is often used for such detailed weights, other data sources such as scanner data, retail sales data and market research data may provide more reliable information, as household budget survey samples can often be small and so lead to statistically unreliable results (see Section 3.3.5).

To distinguish the weights used within elementary aggregates (which are not based on actual expenditure data) from the expenditure weights used at the higher levels of aggregation, compilers often refer to these as either sampling weights or implicit weights (although the latter is somewhat of a misnomer since these weights are explicit). An example of this type of sample or implicit weighting is using data on market shares derived from retail sales data: out of a sample of 100 prices collected for white sliced bread, 80 prices are collected from national supermarket chains, and 20 prices are collected from independent outlets, therefore giving more weight to chain store sales, which should reflect consumers' tendency to purchase most of their bread from these larger stores.

Sometimes, elementary product groups/elementary aggregates can be a broadly defined product (e.g. musical instruments) which may include more than one representative product (e.g. a piano and a harmonica). If their prices are thought to move differently, then it might be more realistic to further stratify the elementary aggregate, for which a finer layer of detailed weights based on relative shares of the total expenditure on musical instruments can be applied to each stratum — data availability permitting. Data sources may include retail sales, market intelligence, scanner data, etc. In each case, it is the relative market share rather than the actual expenditures which is used to derive these implicit weights.

Another option is to narrowly define the elementary product groups/elementary aggregates at a lower level in the aggregation structure; in the above case, two distinct elementary aggregates — one for pianos and one for harmonicas — could be defined. In that case, the market shares for each class of instrument, which could be derived from retail sales data or market intelligence information, could be used as the source of the weights. These weights remain fixed until the next period of reweighting for this level of detail.

3.3.5   Data sources for the weights

Level I weights for the HICP should be derived from national accounts data using the aggregate household final monetary consumption expenditure estimates (see Chapter 2). There are two main practical advantages to using these data for estimating the weights. First, national accounts data are disseminated on a calendar basis, so the timeframe is consistent with the weights reference period of the HICP. Second, and most importantly, the scope and coverage of household final monetary consumption expenditure, adjusted to cover all expenditure by households within the economic territory, is consistent with the scope and coverage of the HICP as defined by the domestic concept.

At lower levels of aggregation below the ECOICOP 5-digit level (i.e. Level II) of the classification system, household final monetary consumption expenditure data may lack the necessary detailed information for deriving the associated weights, so other sources of information must be consulted. Ideally, the data for Level II weights should be available on a timely basis so that the weights can be updated annually. The data used for these weights should also be consistent with the scope of the HICP. For example, using data from a survey of local hotel revenues as a source of weights in the HICP will likely include revenues from business travellers, which are out of scope of the index. In cases such as these, and for lack of a better alternative source, the original data will need to be adjusted to separate the business travellers' portion of the revenues from those derived from household spending.

Often, the HBS is the best option for weights at Level II, but adjustments need to be made to it to reconcile the inconsistencies with coverage (i.e. the HBS only covers private resident households). Other data sources such as retail trade data, market research data, cross-border expenditure surveys and scanner data can be used for Level II weights, but these will often require some kind of adjustment to align their coverage with that of the HICP. If more than one data source is used, there may also be some issues in reconciling different data sources. However, for some expenditure categories, HBS surveys are well-known to underreport expenditure on categories such as alcohol and tobacco; this may require additional adjustments to be made or alternative data sources for these categories to be used.

For Level I weights, this issue is usually not a problem when national accounts data are used as the source of weights, because national accountants will often use a commodity flow approach when conducting the routine exercise of balancing their supply-use tables. In this case, all available information (i.e. domestic production, retail sales, tax information, and export and import data) is used to estimate the supply of products, for example tobacco and alcohol destined for households. Consequently, the resulting expenditure estimates that make up household final monetary consumption expenditure are likely to be less biased and thus more accurate than the corresponding household budget survey expenditure.

For categories below the 5-digit ECOICOP level, where the household budget survey may or may not provide sufficiently detailed information, other sources of information for the weights can be consulted. The guiding principle when selecting sources of weights data at these lower levels (and all others for that matter) is that having some information, regardless of the source, often leads to better results than making do with no information at all. In the latter case, the elementary product group and the elementary aggregate are populated with implicitly equally weighted price observations — an option which may generate an outcome that is far from the reality of the marketplace, leading to an unrepresentative indicator of price change as estimated by the corresponding elementary price index.

The list below provides possible sources of information that can be consulted in order to construct weights for the lowest levels of aggregation below the ECOICOP 5-digit sub-class level. Most likely, these data would be used to weight the elementary product group and/or the elementary aggregate depending on the particular circumstance. This information can either be used independently or be combined to arrive at an estimate, which might be somewhat imprecise but nevertheless useful, for the lower-level weights.

a) If the categories are sufficiently important in the HICP basket, it might be worthwhile to conduct a basic survey with certain targeted retailers to get a general sense of the breakdown of sales for a specific product category. For example, in the example using nuts and dried fruit, a sample of retailers may lead to detailed sales data for these products. From the survey, the compiler could define the respective weights for nuts and dried fruit and split the sub-class into the corresponding consumption segments. Although the method will likely be a better option than not having any weighting information, the quality of the results will depend on the choice of the sample and the cooperation of the retailer. Furthermore, there is a financial and opportunity cost to consider when conducting such surveys.

b) Using existing market intelligence information may also be an option. If there is an association of importers or distributors, other industry groups or marketing agencies and boards, then they will likely have at their disposal at least some general information on the breakdown of sales for the product. For example, the association of peanut distributors in a country may have knowledge of sales volumes and revenues for the different kinds of peanuts that are sold in that country. One disadvantage of this approach is that some of these sales may be to businesses and therefore outside the scope of the HICP; they could even include exports. Further estimating procedures will be needed to subtract these values from the total sales of the product in order to pick out the sales to households and the domestic market.

c) Scanner data is another option that can be used to estimate sales by product category in a similar fashion to that presented in a). However, scanner data offers more detailed and accurate information because of the large number of price observations involved. For example, scanner data may be suited to deriving weights at a more detailed level, e.g. between peanuts, almonds and other nuts. Again, a disadvantage to this approach is that some of these sales may be to businesses and therefore outside the scope of the HICP.

d) Use of the commodity flow approach from the national accounts: production – exports + imports. The same caveat applies here as in b), i.e. sales to businesses need to be excluded.

e) In some Member States, the above data sources may not be available for all product groups. In such cases, an expert judgement approach could be applied when weighting an elementary product group (or elementary aggregate). Take a case where, when constructing an aggregate for men's shirts, no weighting information is available for its two constituent EAs: men's dress shirts and men's casual shirts. If it can be inferred that sales (in terms of expenditure) of dress shirts are greater than those of casual shirts, then one possible strategy would allocate a weight of 60 % to the dominant segment (i.e. dress shirts) and the remaining weight of 40 % to the smaller segment (i.e. casual shirts). Alternative weights would be acceptable as long as dress shirts are allocated the largest weight. The use of expert judgement, particularly where it is based on some type of evidence, is generally superior to using no explicit weights at all.

Explicit weighting at even lower levels than those just described is sometimes used to enhance the quality of the index. This leads to a more complex construction of the index but the final goal of the exercise remains the same and that is to arrive at the best possible indicator of price change given the resources available to the compiler.

Contrary to weighting in Level I, the reference period for the weights used for Level II categories does not have to be the calendar year. For example, it may be a 12-month period such as April to March that differs from that used for Level I categories. Recognising that various data sources may need to be used and that these may not have been produced for the purpose of weighting the HICP, these weights may not map perfectly to the January to December period. Therefore, some flexibility is called for and is acceptable when constructing these lower-level weights.

3.3.6   Combining data sources for estimating weights

As explained above, for higher (Level I) weights down to the ECOICOP 5-digit sub-class, national accounts data are the preferred data source, because they cover all households. Below that level (i.e. in Level II), the household budget survey, market intelligence, scanner data, etc. and combinations of these are often used to estimate weights. As these data sources may not cover non-residents or residents living in institutional households, they may need to be adjusted. How can these differing data sources be combined with national accounts expenditure estimates in such a way that they can lead to an acceptable estimate of HICP weights within the hierarchical structure of the ECOICOP?

The following approach can be applied to obtain the desired weights. Using the chosen data source (e.g. the household budget survey), the percentage of expenditure recorded for each elementary product group (or elementary aggregate) by that data source at the 5-digit sub-class level is applied to the total expenditure estimated for the national accounts data at that 5-digit sub-class, thus producing estimated national accounts expenditure for the elementary product group/elementary aggregate.

For some Member States, national accounts data may only be able to provide reliable data for estimating weights at the 4-digit class level. In such cases the above approach is still applicable, with the inclusion of an additional step to estimate the 5-digit sub-class weights.

As noted above, at this detailed level — especially if the household budget survey is used as the data source — the resulting weights may not necessarily reflect the expenditure patterns of institutional and non-resident households. However, as the published weights and indices (5-digit and above) are based on household final monetary consumption expenditure data, the impact on the higher-level aggregates and the all-items HICP is likely to be, for all intents and purposes, negligible. Additionally, stratifying the index in Level II (the elementary product group and below), even if imperfect, is a superior option to not stratifying it at all.

3.3.7   The weight reference period

Article 2(1) of Regulation No 1114/2010 specifies that the *weighting reference period* is the 12-month period of consumption or expenditure from which the weights are estimated.

Article 3(1) states that this should reflect consumers' expenditure patterns in the weights reference period and should aim to be as representative as possible of consumers' expenditure prevailing in the previous calendar year.

As data for t–1 are not generally available so promptly, Article 3(2) states that the annual expenditure of t–2 obtained from the national accounts should be used to estimate t–1 weights.

Article 3(5) further states that:

> *'Any adjustments made to weightings pursuant to this article shall take effect with the index for January of year t.'*, and *'HICP weights shall take effect with the index for January each year and be price-updated to prices of the preceding December.'*

3.4   Derivation of weights

3.4.1   Treatment of expenditure for categories that fall below the 0.1 % threshold

All expenditure by households which falls within the scope of the HICP should be included. If the weight of an ECOICOP category or product falls below the threshold of 1 part per thousand, regardless of its position (i.e. 4-digit, 5-digit, elementary product group, or other), its weight, should be redistributed at the index compiler's discretion. For example, this may involve redistributing the weight of components at the 5-digit sub-class level under the relevant 4-digit class).

However, in some cases this may not be the solution, even if the weight of the 5-digit sub-class falls below 1 part per thousand. If the product in question is important to consumers (it may have a low price and expenditure but nevertheless be popular among consumers), the compiler could instead produce a new sub-index for it. In that case, the 5-digit sub-classes should not be combined.

Excluding the expenditure is not an option, regardless of its size. If, for example, there is only one other 5-digit sub-class within the 4-digit ECOICOP class, then that is where the expenditure should be allocated. In that case the 4-digit class and 5-digit sub-class will be identical in terms of their weight and index. The difficulty arises when a 4-digit class contains more than one 5-digit sub-class. There are three options available to deal with this situation:

1. Allocate the expenditure of the non-covered 5-digit sub-class equally among the other 5-digit sub-classes in the 4-digit class. This has the advantage of simplicity, but assumes that price movements across those sub-classes are similar, which is unlikely to be true.

2. Allocate the expenditure in proportion to the relative expenditure shares of the 5-digit sub-classes in the 4-digit class. This option assumes that the price developments of the excluded expenditure are unknown but are assumed to be similar to those of the corresponding 4-digit class, which if there is no evidence to the contrary is likely to be a valid assumption. Again, this is relatively straightforward to apply, and it does not affect the price development of the 4-digit class index, which is clearly advantageous.

3. Directly allocate the expenditure to another similar 5-digit sub-class in the 4-digit class. This is also simple to apply, but assumes that the price developments of the two sub-classes are more similar than are those of the 4-digit class as a whole. While this may be a valid assumption in cases where 5-digit sub-classes are comprised of either goods or services, it is very unlikely to be the case if expenditure on goods and services is combined. Care must be taken even if 5-digit sub-classes appear similar, as is the case for the 5-digit sub-classes of alcoholic beverages, as tax and duty rates can and do vary between different types of alcoholic beverage, which can potentially affect the inflation rates measured, especially if there is a change in tax rates.

None of the above options is ideal in all situations; all entail a degree of risk as they are all based on certain assumptions. It is preferable that the reallocation of 5-digit expenditure for which sub-class indices are not calculated should be in proportion to the relative expenditure shares of the 5-digit sub-classes for which sub-class indices are calculated (Option 2), as this is the only option which neither affects the rate of inflation measured nor relies on the judgement of the index compiler. While both Options 1 and 2 would ensure comparable treatment of 5-digit expenditures for which sub-class indices are not calculated, Option 1 is less desirable as it could potentially affect the rate of inflation measured. Option 3 may also be an acceptable or even the preferred approach if there is evidence of similarity in inflation rates, but if there is no supporting evidence this approach should be avoided. In addition, as this option relies on the judgement of the index compiler, it might not be applied in a comparable way in all Member States. Note that the same logic applies if the expenditure recorded at 4-digit class level is too low or insignificant and has to be distributed at the relevant 3-digit group level.

3.4.2   Second-hand goods: the case of vehicles (cars)

Purchase of vehicles includes purchases by households of new vehicles and net purchases by households of second-hand vehicles from dealers (or other non-household sectors). Sales of second-hand vehicles between households are excluded. In the HICP, household expenditure includes expenditure on second-hand cars (and in theory if not in practice, at least, other second-hand goods also bought from dealers) while the sale of second-hand cars to dealers is treated as a negative expenditure. Consequently, the weight for second-hand goods is based on households' *net* expenditure (i.e. the value of purchases minus sales).

The purchase and sale of second-hand cars among households on the economic territory will cancel out, meaning that the net weight is nil for these transactions. However, households also buy second-hand vehicles from dealers and garages, for which the weights will not necessarily be negligible. In some countries, purchases of second-hand cars through these channels actually result in a weight for this category which is higher than that of new cars.

Although household final monetary consumption expenditure does include information on used car sales, it may be grouped with the sales data on new car sales. If the aim is to construct a sub-index for second-hand cars (at the 5-digit level), then a weight for this sub-class will need to be set, particularly so if price developments for second-hand cars differ from that for new cars.

In general, other second-hand goods purchased from dealers, e.g. vintage clothing and items from charity shops, are not included in the HICP for practical (as opposed to conceptual) reasons as it is not normally possible either to define product descriptions or to price equivalent products each month. In addition, the dealer's margins — which would reflect the weight — may be insignificant or unobtainable.

The following guidance on the weights of new and second-hand cars is given in Annex II to Regulation (EC) No 2214/96:

'07.1 Purchase of vehicles

Purchases cover purchases by households of new vehicles and purchases, by households of second-hand vehicles from other institutional sectors, which are typically garages or car dealers. Sales of second-hand vehicles between households are not covered.

Purchases are net of sales by households of second-hand vehicles to other institutional sectors. Member States may take either:

(i)   a net weight for new cars (gross weight minus the trade-in value of used cars) and a net weight for second-hand cars, or

(ii) a gross weight for new cars (not taking into account the trade-in of used cars), and a weight for second-hand cars including any business sector trade-margin.

Purchases also cover purchases through financial leasing arrangements.

Purchases of recreational vehicles such as camper vans, caravans, trailers, aeroplanes and boats are covered by (09.2.1).'

Note: The trade-in value refers to the price offered by the seller to the household for the used car when purchasing a car, be it new or second-hand.

The Regulation offers two options on how to distribute the weight of new and second-hand cars within the total.

The first option is to split the weight into the net weight for new cars and the net weight for second-hand cars. The second option splits the total weight between a gross weight for new cars (not taking into account trade-in value) and a weight for second-hand cars that includes the total trade margin of car dealers in relation to households. The trade margin is the difference between the value of the sales to households and the cost of those cars to the car dealers. (In principle it does not matter here how car dealers subsequently dispose of cars traded in, such as whether these are subsequently exported.)

The first option is preferred but requires that appropriate data is available, while the second option might be more feasible in practice. That is because it does not require data on individual sales but in principle only data on the turnover and trade margin, available from normal business accounts, with an approximate deduction for business cars. The actual calculation of these weights is generally carried out as part of the production of national accounts.

A special situation can occur if car dealers in a country purchase and export many more second-hand cars than they sell to consumers within the country. Then the second option could imply a negative weight for second-hand cars, which would not make sense in the HICP, and in that situation a modified approximation should be applied. Even if second-hand cars are both exported and imported, it could happen that the net flow is an export, potentially resulting in a negative weight for second-hand cars.

The following example in Table 3.1 illustrates the options:

Table 3.1 Purchases and sales of cars between households and car dealers — an example

New cars	Purchases by households	2 000
	Value of cars traded in by car dealers from households purchasing new cars	200
Second-hand cars	Purchases by households	1 000
	Value of cars traded in by car dealers from households purchasing second-hand cars	100
	Sales of second-hand cars by households to the business sector	300

The total weight for all (new and second-hand) cars is 2 000+1 000-200-100-300 = 2 400.

The distribution of weights between new and second-hand cars will be:

1. For new cars: 2 000-200=1 800; and for second-hand cars: 1 000-100-300= 600

or

2. For new cars: 2 000; and for second-hand cars: 1 000-(200+100+300)= 400

The first method is preferable by virtue of being the most accurate, but requires data on how to split the value of trade-in cars between purchased new and second-hand cars. If the value of the trade-in cannot be split or is very small it is recommended that it be deducted from second-hand cars.

In effect, the second, more approximate, method seems liable to undershoot expenditure on second-hand cars and overshoot expenditure on new cars. This is because the second method uses less detailed data and thus cannot appropriately recognise cars traded in.

As ECOICOP is used in the national accounts, expenditures (if available) obtained from them for use in HICP weights should be compliant with the above. If the household budget survey includes specific questions on used second-hand car purchases, then the above net weight can sometimes be obtained from the survey. Alternatively, administrative records of, for example, the value of imported second-hand cars and of changes in second-hand car registrations may provide another 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 cars or *bottom-up* by computing separate estimates and totalling them. Explicit weighting is recommended even when approximate estimates of expenditure are used.

It is recommended that index compilers discuss this issue at national level with national accounts experts.

Sections 3.127 to 3.128 of the *ILO Consumer Price Index Manual: Theory and Practice* (2004) and Section 9.6 of *The Practical Guide to Producing Consumer Price Indices* (2009) provides some additional information on the treatment of second-hand goods in general and second-hand cars in particular.

3.4.3   Newly significant goods and services

Under Article 3(4) and (5) of Regulation No 1114/2010, Member States have a duty to conduct an annual review to determine if the market has changed in such a way that the sub-division quantities have changed between periods. Any resulting adjustments made to weights should take effect with the index for January of year *t*. Article 4 of Regulation No 1749/96 states that the HICP should include price changes for a newly significant good or service and that this should be done within 12 months of their identification either by adjusting the weight of the relevant category of ECOICOP or the weights within that category or by assigning part of the weight specifically to the new significant good or service.

A newly significant good or service in the HICP is defined as a product whose expenditure exceeds the 1 part per thousand threshold — see Article 2(5) of Regulation No 1749/1996. Past examples of goods and services that have been classified as newly significant include internet services, computers, smart phones and mobile telephone services, downloadable music and movie purchases, and satellite/cable television channels. With the timely inclusion of these products in the HICP, the index remains current and relevant by reflecting households' current consumption purchases. Delaying their introduction into the HICP basket results in a loss of representativity and leads to bias in the index.

The annual weights review is intended to pinpoint products which have become significant under this rule for inclusion in the HICP. The fact that an entirely new product may appear — for example *smart watches* — does not imply that they are necessarily significant enough in terms of expenditure to warrant automatic inclusion in the HICP.

Chapter 8 of *The Practical Guide to Producing Consumer Price Indices* (2009) gives guidance on the introduction of new products in the index, with examples on the various technical approaches available for introducing new products into the index.

The Guide makes the distinction between an evolutionary product and one that is revolutionary. A revolutionary product is an entirely new good or service that is not closely tied to a previously available product (e.g. mobile phones when they first appeared). In contrast, an *evolutionary product* is an existing product whose features and, by

consequence, *quality* have changed; for example, it can include newly added features to an already existing product such as a new and improved detergent or a new type of coffee machine that uses capsules instead of a filter.

3.4.4 Calculating the change in the sampling weights within an elementary aggregate

ECOICOP 5-digit level weights are updated every year, whereas expenditure weights at the lower levels (the lowest being the elementary aggregates or elementary product groups) should be no more than 7 years old. Under certain conditions, however, elementary aggregates may be constructed using some form of weighting strategy such as implicit sampling weights to aggregate the price movements of constituent products in order to provide a more accurate elementary price index (see Section 3.3.4).

Table 3.2 shows an example where new data on market shares (based on revenues) becomes available and this new information can be used to update the *sampling* weights within the elementary aggregate for fixed-line telephone calls. By using these weights for averaging the price movements of the component tariff elements within the elementary aggregate, the resulting elementary price index will provide a more accurate picture of price developments for the product represented by the elementary aggregate.

In this example, the elementary aggregate is split into three strata according to the nature of the telephone service: local calls, national calls and international calls, with respective weights (or market) shares of 0.80, 0.17 and 0.03. Note that these weights represent the relative importance of each of the three calling services in the elementary aggregate for a given period, which will likely be the price reference period.

Now let's assume that, over time, consumer calling behaviour has changed and as a result the corresponding revenue shares in a subsequent period are now respectively, 0.70, 0.20, and 0.10. Replacing the old weights with these new weights in the elementary aggregate price index will make the calculated price change for fixed-line telephone calls more accurate.

In Table 3.2, a Laspeyres price index formula is used to calculate the elementary price index for November to December, with a resulting index of 121.4.

Using the same December prices as previously, but this time measuring the price movement to January and applying the new set of weights produces an elementary index for fixed-line telephone calling services of 105.9. From this period on, subsequent monthly indices will be calculated using the new weighting structure until the next update.

Although not shown, had the price movements for period 2 been calculated using the old set of weights, the index for December to January would have been 107.1. The elementary index calculated using the new weights provides a more faithful representation of the overall increase in the price of making fixed-line phone calls over this period.

New weights at this level should be updated annually where possible and refer to December of each year. However, as noted above, dependent on the data sources an annual update at this level may not be possible for all products.

Table 3.2 Adjusting weights within an elementary aggregate

	Price (period 1)				Price (period 2)			
	Old weights	Nov	Dec	% change Dec/Nov	New weights	Dec	Jan	% change Jan/Dec
A- Local Calls	*0.80*	7.00	9.00	28.6	*0.70*	9.00	10.00	11.1
B- National calls	*0.17*	20.00	18.00	-10.0	*0.20*	18.00	16.00	-11.1
C- International calls	*0.03*	28.00	30.00	7.1	*0.10*	30.00	31.00	3.3
	Weighted arithmetic mean of price ratios			**Index**	Weighted arithmetic mean of price ratios			**Index**
	(0.80 x (9.00/7.00) + 0.17 x (18.00/20.00) + 0.03 x (30.00/28.00)) x 100 =			**121.4**	(0.70 x (10.00/9.00) + 0.20 x (16.00/18.00) + 0.1 x (31.00/30.00)) x 100 =			**105.9**

3.5 Price-updating

Though ECOICOP weights are derived from the national accounts expenditure of period calendar year $t–2$, they are deemed to be representative of the consumer expenditure patterns of calendar year $t–1$.

Regulation (EU) No 1114/2010 requires all weights from the ECOICOP 2-digit to 5-digit levels to be price-updated annually, i.e. all expenditure categories in Level I. In contrast, the weights located in Level II of the HICP classification do not have to be price-updated; it is left to the Member State to decide if it wants to do this. In some cases it is not advisable to price update at this level, particularly where an expenditure category has a low weight but covers a variety of products which is represented by only a few representative elementary aggregate indices, e.g. non-durable household goods (ECOICOP 05.6.1).

There are two reasons to price update the weights. Firstly, this exercise is needed in order for each Member State's HICP to be referenced to a common period; this way, the EU and euro area HICP aggregates can be calculated.

The second reason is more technical. Whatever source is used for the expenditure weights, collecting and processing the information for this purpose takes time. As a result, the weight reference period always pre-dates the price reference period. However, if the aim is to calculate a Laspeyres-type price index, as required by EU Regulations, the expenditure to be used for the weights must be adjusted for any price change over the interval between their reference period and the price reference period.

It should be emphasised that updating only the prices while leaving the quantities unchanged does not result in more up-to-date expenditure weights, i.e. price-updating the weights is not a substitute for updating the basket weights from external sources of information such as the latest available national accounts data and/or other sources of expenditure information.

Three requirements follow from Article 3(5) of Regulation (EU) No 1114/2010 (see Section 3.2.1): first, that the HICP should be reweighted every year; second, that the link month (as opposed to another month or another time period such as a year) of the newly reweighted HICP is December, immediately preceding the month when the new weights take effect in the HICP (i.e. in January of year t); and thirdly, that the expenditure weights must be price-updated to December $t–1$ before being included in the HICP in January of year t.

The following is a step-by-step description of the price-updating exercise. The notation used is described below:

$t–2$	is the weights reference year from which the expenditure patterns are determined. For example, the new weights implemented with the January 2017 index are based on national accounts data for the calendar year 2015 price-updated to December 2016.
$t–1$	is the period (calendar year) the household consumption (weights) patterns relate to (normally the previous calendar year except for weights below the 5-digit level).
t	is the year that the new weights will take effect (i.e. new weights come into effect with the January index of each year).
$p_i^{t-2} q_i^{t-2}$	is the expenditure for product i at time $t–2$, which in the case of the HICP is derived from national accounts data or other sources. Note that the product is a generic term to describe a so far non-specified level of aggregation in the HICP classification regime.
p_i^{0t}	is the price of product i in December of year $t–1$, the price reference month or otherwise known as the link month.
q_i^{t-2}	is the *implied* quantity of product i that is inferred from the weight reference period at $t–2$ and for which the information will be drawn either from the national accounts (for annual updates) or a combination of national accounts, household budget survey, and other sources when the reweighting is done at the lower levels of aggregation (usually with the given reweighting cycle of the elementary aggregates).
$p_i^{0t} q_i^{t-2}$	is the price-updated expenditure for product i and where the basket q_i^{t-2} is from period $t–2$, which is revaluated at December of year $t–1$ prices, p_i^{0t}.

The weight reference year is the calendar year $t–2$, i.e. 2 years before the new basket comes into effect in January of year t. The reference year expenditure is defined by the expression $p_i^{t-2} q_i^{t-2}$ as obtained from the national accounts (or another source such as a household budget survey or other data sources) for product i at the weight reference year $t–2$. The expenditure data used should aim to be representative of year $t–1$ household consumption patterns. However, $t–2$ data are used as it is very unlikely that actual expenditure data for period $t–1$ would be available in

time to be included in an index that will be reweighted to the month of January immediately following year t–1. In practice, expenditure from period t–2 is used, as this is the most up-to-date information available for the weights.

Two approaches to estimating expenditure at December t–1. Expenditure can either be price-updated directly from t–2 to December of t–1, or alternatively expenditures from t–2 can be used as a direct estimate of expenditure for t–1, if this is considered the *best available* estimate for the year t–1. Where this occurs, the expenditure must be price-updated from year t–1 to the December of t–1. (See Chapter 8 — Index calculation.)

Note that as the basket of the price-updated weight is the same as the basket from the weight reference period, a product's quantity will remain unchanged between year t–2 and December of year t–1 when price-updating the weight.

When reweighting the index annually in accordance with Article 3(5) of Regulation No 1114/2010, price-updating will be applied to the reference year expenditure values of a product that are consistent with weights found at the 4-digit (class) level or 5-digit (sub-class) level of the ECOICOP classification structure (i.e. sub-index weights).

Depending on how the weights are actually estimated, as a minimum, price-updating should occur at the 5-digit sub-class level. Below the 5-digit sub-class level, countries can choose whether or not to price update the aggregates, including the elementary product groups (or elementary aggregates). Price-updating is, however, not required at elementary aggregate level if the elementary aggregate weights are, for example, estimated as a fixed percentage of the 5-digit sub-class weight (which is often the case) at this level during the basket's one-year life. Take for example the 5-digit ECOICOP sub-class Fresh or chilled fruit, which is further divided into three elementary aggregates: Type A, Type B, and Type C fruit for which a given data source shows that each fruit type has a respective weight (or share of fruit expenditure) of 20 %, 30 %, and 50 %. Price-updating the expenditure weight for the Fresh fruit sub-class would adjust the expenditure weight for each fruit type accordingly, while their respective shares would remain unchanged.

3.6 The treatment of volatile expenditure groups, errors in weights and adjusting weights to reflect the scope of the HICP

3.6.1 Calculating the weight of highly volatile expenditure

Expenditure on certain categories of products, such as furniture, can exhibit significant year-to-year volatility often because samples from the household budget survey (or from other information sources) are weaker for some products, either because the geographical breakdown is too narrow or the value and frequency of purchases are low; the derived weighting information at some of the lowest levels of aggregation (e.g. at the elementary aggregate level) can be of poor statistical quality and thus be unreliable. To remedy the situation, the annual expenditure data can be smoothed by averaging them over a number of years. This should only be performed at the elementary aggregate level and not higher, where as a rule only annual data should be used.

3.6.2 Errors in weights

The greater the variation in price changes among ECOICOP categories over time, the greater the sensitivity of the index to possible errors in the expenditure weights. If all prices behave in a similar fashion, then the weights should not have an impact on the overall HICP.

Two principal sources of errors can distort the accuracy of the weights: (1) sampling errors, and (2) reporting (or non-sampling) errors. Regarding sampling errors, more frequent updating of weights might entail a higher rate of sampling errors, since fewer source data are available at higher frequency or the survey data are based on fewer responses. Non-sampling reporting or keying errors can be controlled for by having statistical or other processes in place to ensure accuracy.

Studies have shown that the estimation of the index is usually far less sensitive to variability in the levels of weights than to changes in the underlying prices. In other words, an error of, say, 10 % in the level of a weight will have a smaller impact on the HICP than, say, an error of 10 % in the price level. Nevertheless, it is necessary to have systematic processes and controls in place to ensure that weights are sufficiently reliable and representative. For example, the weighting schemes between two successive years should be compared and it should be possible to explain major differences. The comparison should take into account all the available information on the nature of consumption in the weight reference period. If errors or mistakes in the weights are found, they should be treated in accordance with the guidance given in Chapter 10.

3.6.3 Example of calculation of a household budget survey weight adjustment to account for the expenditure coverage of the HICP

This example assumes that the 5-digit expenditure weight for lager beer as derived from the national accounts is EUR 500 000 for the reference year and that this value will be the weight for this product. Furthermore, it has been decided that this sub-class will be divided into two elementary aggregates: domestic lager and imported lager. To conduct this exercise, the compiler turns to the household budget survey (or an alternative source) to obtain the share-weight for each of these two products (although a household budget survey in reality would likely not contain such detailed questions, it is assumed for this example that it provides this information).

Lager beer as calculated by the national accounts will include the universe of lager beer purchased on the economic territory of the country, including by tourists, which falls within the scope of the HICP. However, the share or weight of domestic and imported lager beer will exclude non-resident consumption since it is derived from the household budget survey, which by design excludes purchases by non-residents. Therefore, the weights of domestic and imported lager beer will need to be adjusted in order to correct for the under-reporting.

The approach used to estimate the correct share of each category of beer will often vary according to data availability. For imported beer, one strategy could be to use import data as a starting point and apply the following formula to calculate the estimated value of the consumption of imported lager beer:

> Estimated value in € of the consumption of imported lager beer = Value in € of lager beer imports (including) import duties and taxes minus sales in € to businesses (e.g. restaurants and pubs) = €200 000.

For estimating the value of domestic beer consumption the following logical steps can be applied:

> Estimated value in euros of the consumption of domestic beer = Value in € of domestic production minus exports plus taxes on beer minus sales in € to businesses = €300 000.

Consequently, the weight share of the domestic beer elementary aggregate would be 0.60 (= €300 000 / €500 000) while that of imported lager would be 0.40 (= €200 000 / €500 000). These estimates would now reflect all in-scope expenditure on beer for the HICP as a result of the above adjustments.

4

Sampling

4.1 Introduction

The 'universe' of consumer prices covers billions of transactions. It is not practical to observe all these transactions to estimate the average change between two time periods to be compared, so sampling is necessary.

The methods of data collection (and thus sampling) can differ from country to country, reflecting different administrative arrangements. Consequently, there is no single, general sampling method that can be applied to all situations encountered in price surveys.

In this chapter we use 'sampling' to refer to any practice that amounts to including only a subset of all transactions, whether this is done by purposive decision or by probability sampling techniques.

It is well established that for most statistical surveys probability sampling is the preferred practice, although there are exceptions. In surveys designed to collect price observations that will be used for a price index, probability sampling is rarely used except in a few countries; purposive sampling is the most common method used. Although the use of probability sampling could be expanded, there are also good reasons for using non-probability techniques. In this chapter we consider a variety of situations and give criteria for and advice on choosing one method over another in particular circumstances. Examples are given to support these recommendations.

Overall, it should be stressed that for sampling there is no one-size-fits-all solution. For example, the availability of low-level expenditure data and sampling frames for outlets and products varies considerably between countries, and the objective is to make the best use of whatever data is available in each Member State.

The legal framework for the HICP imposes some specific requirements for HICP sampling. These are presented in Section 4.2.

Both the *CPI manual* ([17]) and the *Practical guide* ([18]) have chapters on sampling. Where appropriate, reference is made to information in those chapters; this chapter does not repeat what is already provided there.

Note that this chapter deals with traditional ways of price sampling. Newer approaches, involving scanner data are treated elsewhere ([19]) or as in the case of web-scraping will be the subject of future HICP recommendations (see Chapter 5).

4.2 Legal framework, definitions and terminology

4.2.1 Legal framework

Article 2(6) of Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices defines sampling as:

> *'... any procedure in the construction of the HICP where a subset of the universe of product-offers is selected to estimate the price change for consumption segments covered by the HICP.'*

Minimum standards for sampling are laid down in Article 8 of that Regulation, which states that:

> *'HICPs constructed from target samples which, for each category of COICOP/HICP and taking into account the weight of the category, have sufficient elementary aggregates to represent the diversity of items within the category and sufficient prices within each elementary aggregate to take account of the variation of price movements in the population shall be deemed reliable and comparable.'*

([17])   *Consumer price index manual: Theory and practice*, ILO, 2004.

([18])   *Practical guide to producing consumer price indices*, United Nations, Economic Commission for Europe, 2009.

([19])   Practical guide for processing supermarket scanner data, Eurostat, 2017.

This article provides three principles to be followed by Member States when sampling:

(i) each (published) category of ECOICOP needs to have a minimum degree of accuracy for which a sufficient number of elementary aggregates are needed;

(ii) a sufficient number of prices within each elementary aggregate need to be collected to take account of the variation of price movements with the population of product offers; and

(iii) ECOICOPs with larger weights because of their greater influence on the HICP, need to be more accurate (smaller sampling errors) than those with smaller weights so that the accuracy of the total HICP is optimised.

The scope and the coverage of the HICP are explained in Chapter 2. While all transactions are targeted, it is necessary to aggregate them into product offers for which price comparisons are made over time. The target concept is then the monthly average price.

Temporal sampling

Article 3 of Council Regulation (EC) No 701/2006 of 25 April 2006 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the temporal coverage of price collection in the harmonised index of consumer prices [20] provides a set of rules for the time period covered by the HICP that is relevant to sampling the time periods used in price collection:

> *'1. HICP price collection shall take place during a period of at least one working week at or near the middle of the calendar month to which the index pertains.*
>
> *Where products are known to typically show sharp and irregular price changes within the same month, price collection shall take place over a period of more than one working week.'*

This rule establishes a minimum requirement for sampling in time. Collecting all prices on a single day is not allowed; price collection has to be spread over at least a working week. Where practicable, it is advisable to collect prices over a longer period than just one working week.

Examples of products that often show sharp and perhaps irregular price changes are fresh fruit and vegetables, petrol, and some transport services (for example flights and train journeys).

4.2.2 Definitions and terminology

Consumption segments

The term 'consumption segment' is defined in Article 2(4) of Regulation (EC) No 1749/96 as follows:

> *'A 'consumption segment by purpose' or 'consumption segment' means a set of transactions relating to product-offers which, on the grounds of common properties, are deemed to serve a common purpose, in the sense that they*
>
> • *are marketed for predominant use in similar situations,*
>
> • *can largely be described by a common specification, and*
>
> • *may be considered by consumers as equivalent.'*

Article 2a(4) of that regulation further states the important principle motivating the consumption segment concept:

> *'Consumption segments shall form the fixed objects in the index basket to be followed by the HICP.'*

A consumption segment is a partition of the product universe below the harmonised ECOICOP 5-digit sub-class level. This partition is determined by each country according to its needs and the data available to support such a partition. The following points provide general guidance as to what is intended:

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[20]   OJ L 122, 9.5.2006. p. 3.

- Consumption segments are fixed at least throughout an index link (normally a year). This distinguishes them from product offers, which change frequently, often several times a year.

- Product offers within a consumption segment may be considered by consumers to be equivalent, or to be equivalent by applying appropriate quality adjustments, in the sense that they are substitutable subject to monetary compensation to reflect differences in quality.

- Replacements should be made within a consumption segment and not between consumption segments (see Article 5(7b) of Regulation No 1749/96). Chapters 5 and 6 discuss the replacement of product offers in more detail.

Member States are not required to make an explicit or exhaustive list of consumption segments for the universe of product offers, although they may choose to do so. The concept of consumption segments is intended to help countries to design their samples and give guidance in the selection of replacements and for partitioning ECOICOP 5-digit sub-classes into elementary product groups and elementary aggregates. Elementary product groups and elementary aggregates are defined in Article 2(13) and (14) of Regulation No 1749/96 (see Section 3.3.2).

Newly significant goods or services

Newly significant goods or services in the HICP are defined in Article 1(5) of Regulation No 1749/96 as follows:

'… those goods and services the price changes of which are not explicitly included in a Member State's HICP and the estimated consumer expenditure on which has become at least one part per thousand of the expenditure covered by that HICP.'

Rules for introducing newly significant goods or services are given in Article 4:

'Member States shall:

(a) systematically seek to identify newly significant goods and services, and

(b) check the significance of goods and services reported to be newly significant in other Member States.'

A newly significant product (good or service) can normally be seen as a new consumption segment (or sometimes as comprising several consumption segments). For example, e-books are a new product and thus a new consumption segment within the broader category of books, but within e-books there may be several consumption segments depending on the content (fiction, non-fiction, etc.). The definition covers both completely new products and products that have been available on the market for some time but on which expenditure was previously relatively low. The aim of the rules given in the Regulation is to maintain the relevance of each country's HICP by ensuring that recent market developments are both reflected and captured in the index. Examples of newly significant products are not only technological innovations such as mobile phones and digital cameras but also avocados, gym memberships or new travel packages such as adventure holiday tours, which have recently accounted for a significant proportion of consumer expenditure [21].

Newly significant products should be included within 12 months. They are usually included in the HICP by resampling and introduced in December each year at the time of the basket update.

Two options are given for introducing newly significant products: first, adjusting and redistributing the category weights at the appropriate level of classification; second, assigning a weight to the new product. The choice between these two options depends on whether detailed annual expenditure data from the household budget survey or other sources is available or not (see Chapter 3).

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[21] In the HICP, products or ECOICOP expenditure categories must be included if they account for 1 part per thousand or more of household final monetary consumption expenditure. However, Member States may include products that have not reached this threshold if they are considered as either representative of consumers' expenditure, or the product is likely to exceed the threshold for inclusion in the near future.

4.3 Sampling, resampling and replacements

4.3.1 Representativity and comparability

Generally speaking, sampling amounts to drawing a number of observations that are representative [22] of the target population (or universe). In the particular case of a price index such as the HICP, which measures price change over time, representativity refers to all transactions that occur in the two periods being compared. Achieving representativity in a given month without full resampling that month is the first challenge for index compilers.

Although achieving a representative sample is important for a statistically sound HICP, it is not the only challenge that needs to be considered. The second consideration is comparability, in the sense that we need to find prices that are comparable between two points in time. For this to be possible the product offers must be identical, essentially equivalent or made equivalent by way of quality adjustment (see Chapter 6) over the two periods being compared. The comparability condition is an additional constraint for appropriate sampling in the HICP.

When considering specific recommendations and guidelines for sampling, this dual criterion of representativity and comparability must always be in the forefront of the compilers' mind. Frequently, compromises will be necessary to achieve the best possible balance between these two objectives and examples of such situations are given below. Generally speaking, comparability problems can potentially give rise to a quality bias (non-sampling error) in the index, whereas representativity problems mainly result in sampling errors, which may be random or systematic. It takes judgement on the part of the price statistician, based on experience and training, to evaluate (or gauge) how serious the various risks of errors are in each situation.

Full representativity would require the sample to be representative of the transactions universe in all time periods. However, since the HICP is a Laspeyres-type index, the target sample is defined with respect to the consumption segments and outlets existing in the price reference period. Representativity of the sample is maintained at the lowest level of the index, i.e. individual product offers within consumption segments in the outlets sampled. At that level, the objective should be for the sample to represent the actual universe of transactions in each time period [23].

When a product offer is no longer representative or disappears from the market it has to be replaced. Replacement product offers must satisfy two criteria. First, replacement product offers need to be representative *for the time period* in which they are introduced; and second, it should be possible to compare them to the price reference period product offer (directly or subsequent to some type of quality adjustment). Replacements are one-to-one within the same consumption segment and product specification; that is, a previous product offer is replaced by a new one of the same or similar specification. Prices are then compared between them. In Chapter 6, replacement criteria and quality adjustment practices are discussed in greater detail.

4.3.2 Resampling and replacements

As a fixed-basket index, the HICP should ideally follow the price development of a fixed representative sample of product offers. Given the dynamics of the markets for consumer goods and services, this can be challenging. A compromise has to be found between the two aims of (i) keeping the basket fixed and (ii) keeping the sample representative. So the sample has to be updated on an ongoing basis.

Within each year, the replacement strategies for product offers should aim to ensure that the sample of product offers priced [for each product description] is representative of the current month. While the headline product descriptions remain fixed (e.g. chocolate bar 65 grams, laptop computer with 2GH processor and 4 GB of RAM) some detailed aspects of the product description may change to reflect changes in the market such as package sizes and speed of micro-processors. Where such changes represent a change in quality, appropriate quality adjustments are required — see also Chapters 5 and 6.

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[22] There is no generally accepted definition of representativity applicable to non-probability sampling, unfortunately. It could be said that the sample is composed in the same way as the universe from which it is drawn with respect to relevant variables. This still leaves open the exact variables from which this composition will be judged.

[23] Exceptionally, it may happen that a product specification suddenly becomes obsolete within the year and that replacement/resampling is deemed necessary. In that case, the new specification should still be in the same consumption segment.

Resampling involves a complete review and update of the sample of products, locations and outlets for all product groups and normally occurs in December when a new index link is started and new weights are estimated, as required by Article 3(2) of Regulation No 1114/2010. An explicit part of this review is identifying and including newly significant goods and services (see Section 4.2.2). However, it can be done in any month of the year if the initial product specifications rapidly become obsolete or outlets close.

Unlike the replacement of product offers, which are one-to-one, direct price comparisons between the new December sample and the old December sample that it replaces are not required. Resampling involves an overlap period (i.e. the December of each year) in which the old and new samples are both priced. This forms the basis for annual chain-linking. In the HICP, prices for both the old and new samples are simultaneously collected in December of each year. The index starting with the following January is calculated using only the new price sample. (See Chapter 8 — Index calculation.)

Resampling has two main purposes:

1. It enables new products, new elementary product groups (specifications), new consumption segments, new outlets or outlet groups, and new locations (towns and cities) to be introduced.

2. It enables obsolete products, elementary product groups (specifications), consumption segments, outlets or outlet groups, and locations (towns and cities) to be removed.

New expenditure weights for existing products or outlet groups are usually introduced at the same time as resampling takes place; however, new weights can be introduced without a complete resample.

Compilers should be aware of the distinction between resampling and replacement. Replacements are one-to-one at product offer level. They are triggered by the permanent disappearance or rapid loss of representativity of a product offer and are therefore normally forced upon the price collector and compiler and not planned in advance.

Resampling, on the other hand, is a planned activity, which should occur at least every year. The central office first identifies the new product, outlet or locality that needs to be included in the sample.

Annual resampling is necessary to keep the reference sample representative in a dynamic economy where new products are continuously and rapidly introduced and withdrawn from the market. Resampling can be used to bring new products into the HICP but also to update representation (new models, new outlets, new locations) within a given product category.

As part of annual resampling, the number of consumption segments, elementary aggregates or product offers can be changed and the weights redistributed among them. It is also possible to maintain the old sample stratification, i.e. the sample of elementary aggregates, and elementary aggregate weights and partially or wholly renew the product specifications within existing elementary aggregates.

4.3.3 Different sampling dimensions and their interrelations

There are essentially three sampling dimensions in an HICP; product, geography/outlet ([24]) and time. For each of these dimensions, there is a universe from which a sample will be drawn; in general, prices and price changes will depend on each of these dimensions. For some product groups these dimensions are less pronounced than for others. For example, for utility tariff prices or rentals, the temporal dimension is not as relevant because payment applies to a whole month's worth of consumption at once.

The universe of products is divided into ECOICOP 5-digit sub-classes and within each sub-class a sample of elementary product groups has to be selected. Often a finer sub-division at national level is first needed (ECOICOP 6-digit sub-sub-classes) which is normally also exhaustive. Note that there is no generally agreed 6-digit level for the ECOICOP; however, national sub-divisions should comply with the ECOICOP 5-digit classifications. Such 6-digit groups could be sampled or covered exhaustively, depending on their size. A common procedure is to decide on one or more *representative products* in each sub-class but often a more elaborate hierarchy of elementary product groups and elementary aggregates is used, which is the preferred approach where resources allow. Finally, one or

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([24]) Geography and outlets form one dimension together since outlets are located somewhere on a map. This also holds for internet retailers, although they serve a larger area.

more unique product offers are sampled in each outlet to be followed over time. The detailed procedures for this are discussed below.

The universe of outlets includes all outlets that sell consumer products in a certain ECOICOP category. This universe has a geographical aspect: outlets have a specific location on a map, with internet (including mail or phone order) retailers being an additional category serving the country as a whole.

For the time of price collection (the temporal dimension), the universe is all days of the month, to reflect the fact that consumers can make purchases on any day of the month.

For certain products such as travel services (airfares in particular) the time of day and day of week also matters, because the price paid by consumers can vary according to this parameter (see Section 12.5).

In practice, product groups will have unique features that determine the best sampling strategy. A few examples are given here.

Example 1: 01.1.6.1 Fresh or chilled fruit. These products have highly variable prices over time, including within a month. Therefore, a sampling strategy for collecting fresh and chilled fruit prices needs to focus explicitly on the time dimension as well, and not only on the product and outlet dimensions.

Example 2: 04.1.1 Actual rentals paid by tenants. Prices are normally expressed per month, which makes the time dimension to sampling irrelevant. Also, rents are for single rental units which can be sampled in one or two stages depending on whether there is a central register. So actual rentals are an exception to the multi-dimensional nature of transactions in HICP. (See Section 12.4.)

Example 3: 04.5.1 Electricity. Consumption is continuous over a month and prices are set according to a structured tariff schedule, which may or may not differentiate between different days and hours. If there are only one or a few electric utility companies it is often possible to include all of them and they do not need to be sampled. Where tariffs are decentralised (by region/municipality, etc.) geographic sampling is needed. If a single company offers multiple tariffs, this will require a sampling approach at tariff level. (See Section 7.4)

Example 4: 07.2.2.2 Petrol. For petrol, the time dimension takes on major importance since there are only a few homogeneous varieties of petrol and competition is usually intensive, which often leads to similar prices across outlets, although regional and other differences may exist. But the volatility in oil prices and exchange rates results in prices that change several times each month. So the best sampling strategy for petrol focuses mainly on the time dimension and to a lesser extent on the outlet dimension. If the petrol market follows this pattern, a relatively small number of geographically representative outlets with prices collected several times a month will be an appropriate approach.

4.4 Sampling stages

4.4.1 Sampling of products

Many different approaches to sampling within a certain ECOICOP sub-class can be used, depending on the specific features of the sub-class.

Each country has its own way of partitioning each sub-class based on its national market/circumstances, using a variety of data sources to support this partition. The aim is to produce a set (or basket) of elementary product groups, which are generally referred to as products. Elementary product groups may or may not be further partitioned/stratified into elementary aggregates by location and/or outlet type. Where they are not, elementary product groups and elementary aggregates are the same. Elementary product groups/elementary aggregates are the lowest level of stratification in any given 5-digit sub-class. Elementary product groups may or may not correspond to single consumption segments; in many cases they may represent several consumption segments. For example, the elementary product group *books* may contain e-books and printed books, which could be viewed as different consumption segments within the elementary product group *books*. In this section we focus on the sampling of products rather than partitioning.

Some of the main approaches are described below, noting that often there are at least two stages involved within each sub-class: (1) sampling of elementary product groups; and (2) sampling of detailed products (specifications) within elementary product groups. The final stage, where specifications are transformed into a unique product offer, often occurs in outlets. That is discussed in Section 4.4.3.

Probability sampling is rarely involved in product sampling, for lack of data[25]. Generally, various forms of purposive sampling are employed, such as cut-off or quota approaches. Two examples are described below:

1. *Fresh or chilled fruit, ECOICOP 01.1.6.1.* Each type of fresh fruit (apples, oranges, bananas, grapes, etc.) is a detailed product and an elementary product group and can also be seen as a consumption segment. Some of the main types of fruit have to be included in the sample with certainty if their weights are above the two parts per thousand threshold during a typical in-season period as defined in Article 4(7) of Regulation No 330/2009. Individual types of fruit with weights below the two parts per thousand threshold may also be included depending on the total HICP sample size. Fruit with very small weights can be excluded but if it is generally available in the same outlets as other fruit it can be included at little or no extra cost. Often, practical considerations also play a role here, since the complexity of including strongly seasonal fruit that is not available throughout the year is greater than the routine measurement of non-seasonal fruit. Index compilers generally aim to keep the same sample of products for as long as reasonable quantities are sold. (For fruit and vegetables, this is more easily done than, for example, for clothing products.) Representativity has to be ensured according to a quota sampling approach, where consideration is given to potentially important price-determining factors such as domestic versus imported fruit. For example, small domestically produced fruit such as various berries (strawberries, raspberries, blueberries, etc.) could well have special price movements that should be captured based on their combined weight rather than on their separate weights. This could be done by assigning the total weight of berries to the most widely available type of berry. The treatment of seasonal products is described further in Section 7.1.

2. *Non-motorised small tools (for house and garden), ECOICOP 05.5.2.* Each tool type in this group (hammer, screwdriver, pincers, pruning shears, etc.), of which the universe is quite large, may be taken as a consumption segment, but the total weight of the whole group is relatively low. Within the group a sample of tools/segments needs to be selected. If the household budget survey or scanner data provides detailed expenditure data at the level of individual products to support a probability proportional to size (PPS) sampling approach, then this method could be chosen. Where such detailed data does not exist, the most practical and perhaps best choice is to apply the cut-off sampling technique for those tools with the largest expenditure shares using aggregate household budget survey data (if it exists) for aggregated product groups such as garden tools, woodworking tools, tools for plumbing, etc. Samples can also be drawn from alternative data sources such as scanner data from do-it-yourself (DIY) stores or retail sales surveys. In the absence of any data, subjective judgement is the fall-back approach. At that stage, considerations of comparability and cost are important factors in the final selection of elementary product groups.

Detailed product sampling

Within each sampled elementary product group, one or more product specifications are selected depending on the homogeneity and relative size of the elementary product group (in expenditure terms). Since a sampling frame of specifications is usually unavailable, some form of purposive sampling has to be used in this stage. This procedure is usually referred to as the *representative item* (product) method. Several crucial choices are involved in this stage.

How many products are needed? There need to be enough to *represent the diversity of products within the category* so a minimum number is needed for each ECOICOP sub-class in order for the ECOICOP index to have a minimum accuracy. Furthermore, the weight of the sub-class and the diversity within it has to be taken into account. Clearly, this depends on the total sample size; this issue is further discussed in Annex 4.1, at the end of this chapter, under *Optimising sample sizes per product*.

The sampling strategy within an elementary product group can take many different forms. One strategy would be to perform the whole sampling operation from elementary product group to product offer in the outlets without intermediate sampling steps. This corresponds to a strategy of loose specification, which is discussed in more detail below.

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[25] New data sources such as scanner data would allow probability sampling but also enable completely new approaches covering the whole universe.

The issue of tight or loose specification is relevant for products where a second stage of sampling is performed in outlets. A 100 % tight specification does not give any latitude for choice by the price collector once in the outlet, and is thus fully defined with respect to brand, size, etc., e.g. Absolut vodka 75cl (unflavoured).

An extremely loose specification, e.g. *vodka*, on the other hand, allows all product offers that belong to the segment to be selected on the basis of a sampling rule in the outlet such as *most sold* or *well sold and lasts long*. In between these extremes are various semi-tight specifications that reduce the scope for local choices without completely eliminating them.

It should be stressed that the tight/loose distinction refers to the central specifications, i.e. the general description that is often provided by the central office and within which a price collector is asked to select a product offer. A loose specification thus becomes tight in the outlet after the price collector has selected the product offer.

Neither tight nor loose specifications are universally superior (see Chapter 5 — Price collection). A tight specification allows better central control over the sample and may enable the use of centrally available market data that, for example, indicate that certain brands and models are currently popular, where a loose specification might run the risk of local price collectors missing (i.e. not selecting) important products. Tight specification may also enable stricter quality control, since prices can more easily be checked for accuracy, reliability, etc. by having more comparable prices available for validation purposes.

On the other hand, a loose specification allows for easy adaptation to local conditions and to the range of available product offers in each given outlet. Thus, greater overall representativity can be achieved for many products. A tight specification will give rise to more missing price observations, since a number of products that meet the requirements dictated by the product description may not be found. Therefore, a tight specification could make replacements more difficult whereas a loose specification fits with an instruction to price collectors to find a replacement product offer with the same specification, which is more easily accomplished.

Index compilers should be aware of the fact that tight product specifications may result in a loss of representativity with regard to the target universe. Tight specifications therefore amount to a purposive sampling method in themselves (unless they are based on comprehensive datasets which allow PPS/cut-off sampling, e.g. scanner data). For both tight and loose specifications, care should be taken that, taken together, the specifications do not result in exclusion or misrepresentation of a significant market segment with common price-determining features such as domestic versus imported products, luxury versus standard quality, and the like. Ideally, the sample should be based on the market share, in value terms, of each of these features for a given product. Although such information is rarely available in detail, it is still possible to achieve a broadly correct representation with good judgement and a quota sample philosophy.

In general, it is often better to choose an option between extremely tight and extremely loose specification. For example, some generic features of a product may be specified, but not the brand or exact package size/type. However, it is generally good practice to specify the range of package sizes allowed (e.g. single can of beer, 33-50 cl, but not multipacks), along with instructions to record the size and price observed. This is because the unit value prices of products often vary with package size, not all of which are necessarily representative [26]. Other factors play a role as well, such as the capacity of price collectors to act according to more or less complex instructions. In this context, investment in proper training of price collectors is essential. If specifications are loose, then price collectors need to provide additional notes and comments to head office on the selected product offer and to be able to judge comparability within clear national guidelines, etc.

A special problem in the case of tight product specifications (for which there is no easy solution) is that for certain categories of products, for example fashion clothing, furniture and technological products, it is more difficult to find prices over time than it is for others, depending on what counts as an essentially identical product [27]. However, such products may be important in terms of expenditure share and may exhibit potentially different price movements. An example is clothing [28], in particular women's/men's fashion clothing sold in specialised clothing boutiques. Clothes that are in fashion are typically sold for only a few months and are then replaced by new styles. Even the boutiques themselves may be short-lived. Excluding clothes that are in fashion would amount

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[26] Representativity also depends on the elementary aggregate formula. If the Dutot formula is used, the price level will be part of the implicit weight. It should then be the quantities purchased that are representative. For example, luxury products should be included in their quantity proportions instead of their value proportions. If the Jevons formula is used, then the value proportions should be used.

[27] This topic is discussed more in Chapter 6 — Replacements and quality adjustments.

[28] Another example would be big concerts with world-famous artists and expensive tickets. Including them may require a quality adjustment between Madonna in one month and the Rolling Stones another month.

to a possibly severe representativity problem, but including them could lead to a comparability problem at least as severe, not to mention the cost of the extra complexity of processing and compiling the HICP. In such cases, where a Member State judges that comparable product offers are impossible to price, exclusion is sometimes the least bad solution. But only in extreme cases should this argument be invoked.

4.4.2   Sampling of locations

Unless it is possible to sample outlets directly from a national sampling frame such as a business register (which often cannot identify small outlets), the sampling of outlets generally needs to be done in two stages. In the first stage, a sample of locations such as cities or shopping areas is drawn/selected in each region of the country, and in the second stage outlets are sampled. The first stage, which is referred to as cluster sampling, will be discussed in this section and the second stage in the next section.

When sampling locations, two major factors must be borne in mind; representativity and cost effectiveness. Areas where the bulk of consumer purchases take place need to be covered with certainty or by a probability sample to make the sample representative. In a large country divided into administrative units (state, region, department, etc.) all of these regions are often included with certainty, after which there may be sampling of locations within each of them. This is conducive to representativity where price movements may differ due to different climates and/or transport costs. It is also a necessary requirement where there is a demand for separate price indices for each region.

A factor that complicates the sample of locations is that, depending on how they are demarcated, they may cover different parts of the product spectrum. Ideally, locations need to be demarcated so that most products can be found in each location. Otherwise it may be necessary to have separate sampling methods for some products — for example for new cars and DIY products, because car showrooms and large DIY stores are often located outside the main shopping districts.

Locations should then be listed together with a relevant size measure (relating to the effective size of the purchasing population) and a sample selected based on this list. This ideal size measure is total sales to private households, for which a proxy could be the number of staff in the outlets or their 'footfall' — the number of people shopping in them.

However, one must accept that not all products will be found in each location, and the sampling frame will need to be adjusted by drawing different location samples for different product groups.

In small countries it is common to select a few of the larger cities for price collection. This leaves out smaller towns and rural areas, but as consumers living in areas close to city will go there for some of their shopping the effect of their exclusion will be smaller than might be inferred from population numbers, and sufficient coverage may still be achieved. It is then important that the selected cities are such that their outlets are used by a large part of the population and that they are situated in different parts of the country for maximum coverage. Car-friendly shopping centres situated immediately outside a city should be included if they are significant.

With regard to small locations (villages, small high streets, etc.) situated far from regional offices, some cut-off approach to exclude such locations is acceptable on cost grounds.

Location samples are generally fixed for a long period of time, as they determine the whole organisation of work for the statistical office. This is probably the major reason why purposive location sampling has been the rule so far. However, probability sampling for locations is also possible and an example of this is provided below.

Example: Probability sampling for locations in the UK

Probability-based location sampling is used in the UK. The UK's Office for National Statistics used a database with 1 200 shopping centres in the UK ranked by the size of the population they serve, and has modified this so that areas around these centres are also included.

The country was divided into regions [29] and location selection took place separately within each region, using systematic PPS (probability proportional to size) sampling with the size measure being the number of employees in the retail sector (but other statistics such as population numbers, which are more widely available in all countries,

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[29]   Broadly corresponding to NUTS1 regions.

would also be a possibility). The number of locations in each region was determined as the proportion of national expenditure taking place in that region, multiplied by the total number of locations to be visited nationally. In the UK the sample of locations is rotated over a five-year period, with roughly a fifth of the sample updated each year.

The details of the method are given in Chapter 3 of the UK's *Consumer Price Indices Technical Manual* ([30]).

The purpose of the location sample is to make it possible to construct tailor-made sampling frames in each sampled location. In the next section this is described in more detail.

4.4.3   Sampling of outlets

The objective of outlet sampling is to determine a representative set of outlets that sell the selected products. The sample also needs to reflect the diversity both of product varieties within the selected products and of types of outlets with different service and price levels.

For outlet sampling it is important to distinguish between probability sampling and purposive sampling; these are dealt with in separate sections below. In addition, there is the separate process of matching the product sample with the outlet sample.

The outlet sample needs to be representative of both the location and types of outlets. Price levels and thus price change patterns may vary in both of these dimensions. Special attention needs to be given to internet retailers, which have increased their market share across most product groups over the last few years. They should be included according to their approximate expenditure share for each product group.

Probability sampling

Where sampling frames exist for outlets, probability sampling could be considered. A sampling frame could be, for example, a central business register or another type of register with broad coverage. Coverage is crucial: the register should cover all kinds of outlets, large and small, and have systematic update procedures so that new outlets are regularly added to the register, and outlets that have closed are removed.

Sweden draws a sample directly from a central sampling frame. It uses an order PPS technique to draw a sample of outlets from the Central Business Register. New samples are drawn each year to ensure maximum representativity of the current outlet universe while at the same time a permanent random number technique results in some 70-75 % of the sample remaining from one year to the next.

The Swedish method is described in the CPI manual (paragraphs 5.18-23) and in the Swedish CPI handbook ([31]). (It has recently been decided for cost reasons to exclude some outlets which price collectors needed to travel long distances to reach.)

Where a central sampling frame does not exist, a two-stage sampling procedure is needed if probability sampling is to be applied. The best-known example is the UK. The first stage, the sample of locations, was discussed at the end of Section 4.4.2. In each sampled location the outlets are listed by price collectors who note details of all retail outlets found, including types of goods sold. A sample is then drawn from the tailor-made sampling frame by means of either PPS (using net retail floor space as the size variable — a proxy of turnover) or simple random sampling.

Sweden's and the UK's methods might, with some variation, be applicable in other countries. The UK method, however, could be relatively resource-demanding. The use of probability sampling using either approach depends on the availability of the requisite data, which may not exist in all Member States.

Non-probability sampling

Without probability sampling, other strategies are needed to achieve representativity. One such strategy is quota sampling. For outlets, this means selecting the sample so that the sample fraction corresponds approximately to

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([30]) http://webarchive.nationalarchives.gov.uk/20160108054359/http://www.ons.gov.uk/ons/guide-method/user-guidance/prices/cpi-and-rpi/cpi-technical-manual/consumer-price-indices-technical-manual--2014.pdf

([31]) *The Swedish Consumer Price Index — A handbook of methods*, SCB, Örebro, 2001.

the population fraction for certain variables that are considered important — for example, region and outlet type. In principle, this must be ensured for each product, or at least each product group.

A straightforward strategy is first to determine the sample size needed for each product specification in each city/location, and then to ask local price collectors to find a representative outlet sample for each product based on their knowledge of which outlets are frequently visited. They should then be instructed to take diversity into account in the specification. For example, a 100 % cotton T-shirt represents a diverse product which can vary enormously in both price and quality and which requires a larger sample than, for example, a packet of 20 cigarettes for which the price level and quality differences are less pronounced. For food products, the sample should include market stalls, local shops, supermarkets and hypermarkets, in proportion to their expenditure share and the elementary aggregate formula used (see footnote 24, in Section 4.3.3). For clothing chains with markedly different price levels, the various price strata should ideally be represented in the sample based on their market share in expenditure terms (if such data are available) unless comparability problems are deemed insurmountable. For internet retailers, head office staff should carry out sampling centrally.

Matching the outlet sample with the product sample

In the end, an HICP sampling frame has to specify exactly which products are to be priced in which outlets.

It is not usually known in advance exactly which products can be found in each outlet. Ideally, compilers need to know where households buy each product and let this govern the allocation of products to outlets. There are a number of possible approaches to obtaining this information. Some are outlined below.

One approach is to use an *assortment survey* directed at the outlets (or outlet chains) where they provide the relative turnover share by type of product. This could guide the allocation of products to outlet types, leaving the actual products in a preliminary sample of outlets to be checked after that.

Another approach is to list (by outlet type & size) all outlets in the locations sampled, from which a sample of outlets can be randomly selected. To enable this, various product types are grouped together based on the likelihood of their being sold in the same types of outlets; for example, food and non-durable household goods (cleaning products etc.) are priced in supermarkets/food shops, and medicines & beauty products are priced in chemists

A third approach would be a *point-of-purchase survey*, where households are asked where they make their purchases of specific types of products. This information can then determine the type of outlets in which to price each product. This method is used in the US, but, as far as is known, nowhere in Europe. It appears to be quite an expensive method, is subject to non-response problems, and the findings of such a survey cannot be expected to hold true for a long time.

In most countries, this process of matching products to outlets will be based on the informal local knowledge of price collectors, but care should be taken that the full range of outlet types is covered. If sample sizes in each location are small, not all outlet types can be included everywhere. In that case, central allocation is needed, for example to rule that location X will include a local shop but location Y will include a supermarket, so as to ensure the right balance in the overall sample.

In the end it will still be necessary to visit each sampled outlet in advance of the first price collection for the new sample of locations, outlets and products (in December of each year) to find out their exact assortment of products and which of the specified products are actually sold there. Note that in December, prices should be collected for both the old and new samples.

Generally, it is both reasonable and preferable (for efficiency reasons) to collect prices for all or most of the representative product specifications within the basket that are sold in a sampled outlet. This is because the extra cost of pricing one more product in a given outlet is small compared with having to collect additional prices (i.e. increasing the sample) by surveying prices from an additional outlet. Issues regarding administrative burden, efficiency and effectiveness are discussed further in Chapter 5. However, if this strategy is followed, then the prices recorded have to be reconciled with the explicit or implicit self-weighting pattern within or between elementary aggregates with regard to outlets or products. This is particularly critical for larger outlets and outlet types such as hypermarkets that may stock many product offers which meet the product specification. Therefore, care must be taken to ensure that a sufficient number of outlets (as well as prices) are included in the sample to ensure that the sample is representative of where consumers actually shop. This is particularly important for non-food retailers, restaurants, accommodation services, etc., where the range of outlets is diverse and where sales are not restricted to a few dominant retailers.

4.4.4   Sampling of product offers in outlets

Once it is decided to price a product in a sampled outlet, a unique product offer has to be defined. This is typically in the final sampling stage in a CPI or HICP, unless the product is already so tightly defined that no further sampling in the outlet is needed.

In Europe, purposive methods are used at this stage and the approach most often cited is to choose the *most sold* product offer in the outlet. Another criterion that is sometimes used is that the product offer should *last long*, i.e. be generally available over many months in order to minimise the frequency of replacements. Although both of these criteria make sense they are not always compatible and a compromise has to be found. When initially choosing the product offers, the knowledge of the shop assistants can be invaluable and their advice should be sought as necessary, if possible.

Where several similar product offers are differentiated primarily by brand, it may not always be possible to identify the *most sold* product. Likewise, expensive varieties may sell fewer units than cheaper varieties but account for a larger share of total revenues for the outlet in question. For some products like electrical goods, it may be possible to obtain sales data from market research companies or scanner data from the retailer in order to sample the most sold products remotely from head office, thus removing the potential bias arising from the subjective choices that an individual price collector can sometimes make. However, such remote sampling procedures can be expensive to implement and maintain, and therefore are not always a practical approach in resource-limited situations.

The *most sold* approach (to ensure representativity) amounts to a cut-off sample of one unit and is generally a sound sampling strategy. The *long-lasting* approach (to ensure comparability) is more dubious, since it may result in a sample that is less representative, by excluding popular sellers that exist in the market only for a short period. If comparability problems are deemed too difficult to overcome, the long-lasting approach may be unavoidable to some extent but it should be applied with restraint. Infra-annual resampling is also an option for high-turnover items.

One of the pitfalls of the *most sold* criterion has to deal with products that are often subject to sales prices or temporary price reductions. Unfortunately, such products have become more and more common in modern markets. For example, if a product offer has a temporarily reduced price in the week when price collection occurs then it may be the most sold that week but not over a longer period. If such product offers are disproportionally selected in the price reference period, i.e. the December of each year when a new sample is first priced, then price increases will be recorded in the following months once they return to their normal price level. This results in an upward bias in the index.

This problem with the most sold criterion can be overcome if the most sold reference period is longer than a week or even a month. If a shop assistant is asked for the *most sold* it should be specified that it is the most sold over the last month or longer.

Note also that a rule never to include a product offer with a temporary price reduction in the price reference period sample can also give rise to a bias. In that case, it is a downward bias, since future price changes will disproportionately be decreases, because price increases following the end of temporary price reductions will not be captured in all time periods. Ideally, the share of normal versus temporarily reduced prices in the sample should reflect their shares in the universe in each time period. The best way to achieve this is by defining the selection criterion irrespective of the temporary price level at the time the price collector makes an initial sample selection. (Since prices have to be those actually paid by the consumer, excluding temporarily reduced prices is not an option.)

It is also possible to use probability sampling at this stage and this approach is used in the US. Basically the expenditure share of each product offer that falls within the specification is estimated in the best way possible and a PPS sample of one product offer is drawn in each outlet. The exact procedure is described in BLS (2013) [32].

4.4.5   Product and outlet sample; central price collections

For products where the central office performs both the sampling and the price collection, the distinction between tight and loose specification is usually irrelevant. Instead, a sufficiently large sample of tight specifications is defined

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[32]   Chapter 17, 'The consumer price index', in *Handbook of Methods*, BLS, 2013. http://www.bls.gov/opub/hom/

centrally to allow a price to be collected from the internet, by phone, from a catalogue of some kind or from another centrally available data source. (See Chapter 5.)

In some cases, it is possible to cover the whole universe of transactions (i.e. there is a census of transactions). This is especially the case for certain administrative fees like TV licence fees, where an ECOICOP sub-index or an elementary product group weight may be represented by only a few prices or even a single price. For state-run monopolies (for example, alcohol sales in Sweden or Finland) it may be possible to get access to the state-run retailer's database and extract all or almost all of the prices from that source.

For some products, such as electricity, telecoms, cultural services and certain transport services, prices may take the form of tariffs with a limited number of prices within them. In other cases, national pricing structures may operate, in which case only a single price needs to be collected. In addition, there are some product offers, such as annual memberships of clubs or museums, where prices may only change infrequently or once a year. In such cases central sampling and price collection may represent a cost-effective solution. In many of these examples, it is often feasible to cover the entire universe of prices, albeit sometimes using special methods (see the examples below).

However, there are product groups in central price collection where specific sampling solutions are needed. In the examples below, the focus is on the sampling method and not the other aspects of index methodology. These examples demonstrate methods that are also applicable to other product groups.

Package holidays — a case for quota sampling

The sampling unit for a package holiday is a completely specified holiday occurring in a defined time period. The specification of a holiday typically includes at least the following variables (i) destination, (ii) point of departure (airport), (iii) tour operator, (iv) hotel, (v) meals included, (vi) number of people travelling and (vii) other travel and in some countries cancellation insurance.

An ideal sampling frame would list each possible combination of these variables but this is of course not practical. However, at least for some of these variables, relative frequencies are known. The first three are sometimes available from official sources in the form of expenditure shares, and tour operators can be asked about relative frequencies of types of hotel and numbers of people sharing rooms, etc.

In this situation, quota sampling is the most practical choice. In a quota sample, it is possible to make a purposive sample such that all the known relative frequencies in the target universe are reflected, at least approximately.

Car insurance premiums — probability sampling feasible

The target universe is all car insurance policies in a time period (year or month). Each insurance company will have a register of these policies including all price-determining factors such as type and age of car, age and location (residence) of the owner, etc. It may also be possible (as is done for example in Sweden) to ask each insurance company (they typically employ many statisticians), to draw a small random sample of policies from its own register and then note all price-determining characteristics of the policies selected (note: no personal data should be included). If that can be done, a probability sample is feasible. If companies are not willing to supply data, it may be possible to statistically sample insurance providers by relative expenditure share or number of policyholders. In terms of the actual policies priced, purposive methods based on the main price-determining characteristics are the only feasible approach.

New cars — PPS sampling

Many countries have a central car register with information on the brand and model, in which every new car is registered. Based on this, the index compiler could list all models, top-down according to total expenditure (the average price per model would have to be estimated), with the number of cars purchased. Care should be taken to distinguish household purchases from other transactions. A PPS (Pareto or systematic) sample could be drawn using expenditure per model as the size variable. An advantage of the Pareto method (see the CPI manual) is that an automatic method of excluding models that are out of scope (no longer sold or sold mainly to businesses) can be devised that guarantees that the final sample is still scientifically determined.

More detailed issues on coverage and other aspects of using a car register for sampling are discussed in Section 12.3.

4.4.6 Sampling of points in time

Each country has its own specific rules concerning the price collection period, within the limits set by Article 3 of Regulation (EC) No 701/2006 on temporal coverage. Within these specific rules, the prescribed methods of sampling points in time are usually not very detailed and price collectors may be given a lot of leeway as to when exactly to visit an outlet as long as they meet the deadline. For most products there is no problem with having less control over this aspect of sampling, since few prices change within a week and the price collectors' choice of exact time will not have any noticeable effect on the result. Ideally, however, price collectors should aim to collect prices from a given outlet on the same day each month.

Spreading price collection across the week is best achieved by setting a schedule for the price collectors to visit outlets on different days of the month. Often, price collectors are given the option of deciding the day and hour of visits themselves within given period such as 1-2 weeks in the middle of the month. Where this occurs, care should be taken that price collection (as a whole) is not concentrated in just a few days.

Where prices are volatile in the short term, they should be collected several times a month from the same outlet. Examples of products that often show sharp and perhaps irregular price changes are fresh fruit and vegetables, fish, petrol, and some transport services (for example flights and train journeys). In the case of fresh produce, it is not uncommon for market prices to fluctuate up or down by 50 % or more within a month. For transport services, prices can vary according to the day of the week or time of day and the timing of public holidays. (See also Chapter 5 and Section 12.5)

For certain products, for example some travel services, the time of day and weekday are important price-determining factors. The sample will then have to be specified in terms of time so that it is representative of household purchasing patterns.

Annex 4.1: Variance estimation and optimal allocation

Errors in HICPs fall into two categories: sampling errors and non-sampling errors. This section discusses sampling error.

Variance estimation can provide useful information at least for guiding decisions on sample sizes and allocating samples among the different products and outlets.

It might also be used to inform users about the likely margin of error of published index numbers. It is recommended that Member States show restraint until any particular variance estimation model has been analysed carefully.

Strictly speaking, calculating the sampling error in surveys by means of variance estimation requires probability sampling to be strictly valid. Since probability sampling plays a relatively minor role in the compilation of most CPIs and HICPs it is generally not possible to obtain reliable estimates of sampling error. Yet it is not entirely unreasonable to assume that samples are in many cases effectively random, i.e. the sample structure is such that it could have been generated by a random procedure.

Bearing in mind these initial disclaimers, this section discusses a simplified approach to analysing sampling errors that should be helpful in many countries. First we discuss variance estimation and then we move on to the issue of sample allocation.

However, we should note that it is even more important to minimise biases that mainly arise from inappropriate treatment of quality change rather than sampling error. This has to be kept in mind when designing price samples — sometimes it is easier to keep control of quality change for complex products in a smaller sample.

Variance estimation

A very general form of HICP is $I = \sum_{i=1}^{N} w_i I_i$, where i denotes products, w_i the weight ([33]) of the product and I_i the product index. If the estimation of each product index were independent of each other the variance would be:

$$V(I) = \sum_{i=1}^{N} w_i^2 V(I_i) \tag{4.1}$$

where $V(I_k)$ denotes the variance of the product index i.

However, product indices are not statistically independent. The main reason for this is that it is common practice to sample many products in the same outlet so that the same price-setting behaviour by an outlet can potentially affect many products. The sampling errors of the product indices are therefore correlated, which leads to equation (4.1) probably underestimating the total sampling errors to some extent. The CPI manual (paragraphs 5.74-97) gives examples and references to models where these correlations have been taken into account.

As a first approximation and in particular for the purpose of allocating the sample, the simple equation (4.1) is still a useful starting point. The next step is to estimate the product variances $V(I_i)$. Note that these variances refer to variation in price change and not to price level.

If a product is represented by just one elementary aggregate then $(I_i) \approx \sigma_i^2 / n_i$. Here σ_i^2 is the simple variance among the elementary aggregates n_i product offer indices. ([34]) If instead the product index consists of several elementary aggregates (strata) the equation becomes $(I_i) \approx \sum_{h \in i} w_h^2 \sigma_h^2 / n_h$, where now $h \in i$ refers to each stratum of the product index i. The elementary aggregate could for example be sub-products within a main product group or different cities/locations. Again, we are not considering correlations among elementary aggregates within the product.

For small countries with a simple sample design and without significant resources for analysing sampling error, the above approach could be a useful starting point for an analysis of sampling errors. Larger countries with more complex sampling design may well want to take into account the peculiarities of its sampling design and the various correlations that follow from it. The CPI manual (paragraphs 5.73-97) outlines some ideas on how to achieve this.

Optimising sample sizes per product

The number of products available to consumers is enormous and it is simply not possible nor affordable to collect prices for every product available in the market. Generally, for reasons of cost most countries' HICPs have between 500 and 1 000 product specifications in their basket of goods and services. As some types of products have fixed national prices (e.g. utilities with a tariff) the number of product specifications required is low even though their weights within the HICP are high. Conversely, some products such as fruit are extremely diverse in both the range of varieties available and in price changes within a year, but their individual weights are generally very small. Given these factors, how can the sample of goods and services best (or optimally) be allocated among the ECOICOP categories with the limited resources available for price collection? This section describes how the sample size can be determined in an optimal way to reflect its relative importance in the measurement of overall inflation.

Optimal allocation of the sample aims either to minimise sampling error within a given budget or to minimise the cost of producing the index for a given sampling error. The natural starting point for an analysis of allocation is the Neyman allocation formula. For a CPI or HICP it can be written as:

$$n_i = n \frac{w_i \sigma_i / \sqrt{c_i}}{\sum_i w_i \sigma_i / \sqrt{c_i}} \tag{4.2}$$

The new component in this formula is c_i which denotes the cost of measuring one sampling unit of product i.

Expressed in words, this formula states that the sample size for each ECOICOP product group should be proportional to its weight within the HICP and to the standard deviation of price relatives but inversely proportional to the square root of the unit cost of measurement.

([33]) Here and below w denotes weights that are standardised so as to sum to 1.

([34]) The $\approx$ symbol signifies that the expression is approximately correct when the Jevons (the ratio of the geometric mean of prices or the geometric mean of the ratio of prices) or the Dutot (ratio of arithmetic mean of prices) formulas are used.

Of these three components, the ECOICOP weight is straightforward and generally changes relatively slowly through time — normally once a year. Cost per unit requires detailed information on time spent in the field but rough estimates can still be helpful. For example, fast-moving electronic goods like TVs or computers are much more time-consuming to monitor than simple food products for which the quality features generally do not change. Note that only the relative cost of collecting prices is needed in the formula, not the absolute cost in monetary terms.

The most complicated factor to account for in the Neyman allocation formula is the standard deviation σ_i of the price relatives, i.e. how heterogeneous the price movements of all possible products within each ECOICOP 5-digit sub-class are. Three factors contribute to this complexity:

1. Equation (4.2) as it now stands is strictly valid only for a special form of probability sampling — simple random sampling (each sampling unit is drawn with equal probability). For stratified sampling, the formula can be modified fairly easily but with other sampling designs it may prove more difficult. For non-probability sampling, an assumption that the sample is in some sense effectively random has to be made.

2. σ_i varies over time and the variation could be considerable. For example, it may be different for a one-month change versus a 12-month change. Furthermore, occasional price wars or the like may affect σ_i so that an estimate of σ_i for a historic period is not necessarily valid for the future. Since it measures the variation in price change across outlets, it depends on the intensity of competition activities in the market, which could change.

3. As discussed above, correlation between product variances also makes the estimate of σ_i difficult.

For this reason, a simplified strategy for the purpose of the optimal allocation of the sample is recommended for small countries with limited methodological resources. The strategy has two components:

1. As a first approximation, sample sizes for each product or stratum within the product should be proportional to the weight of the product or stratum. If the accuracy of the product index itself rather than only the overall HICP/CPI is considered crucial, then a minimum sample size per product is also needed.

2. The sample sizes are then modified, taking cost and standard deviations into account. Relatively crude estimates can be helpful here. For example, price collectors can be asked about how much time they normally spend on each product and calculations of standard deviations can be done for earlier time periods and for different time spans (1 and 12 months for example). As described above, it is only the relative cost and the relative standard deviations that are needed in the formula, not the absolute values. A factor that also should be taken into account is that it is less expensive to sample an additional product in an already sampled outlet than to add another outlet to the sample.

Below are some examples of how to reason about sample sizes in a practical way for a number of product groups.

Petrol. Normally, petrol prices show little variation among outlets on the same day whereas they can vary considerably even over a month (petrol is an example of a product with irregular price movements referred to in Article 3(2a) of Regulation No 701/2006). It would thus make sense to have a relatively small sample of outlets but follow prices several times in the same month. However, the cost of price collection is normally small (telephone or email inquiries can often be used) and if so a larger outlet sample could still be justifiable in order to be prepared for the rare occurrences of price wars between petrol stations.

Computers. Because of competitive pressures, prices for a specified computer model do not normally vary a lot among outlets, especially not within the same chain of outlets. At the same time, the cost and complexity of price collection are high because of the volume of information that needs to be collected along with the price. This situation calls for a relatively small number of outlets and models, with great care taken instead to be precise about the detailed specifications for each model (the product offer). This is the case irrespective of whether a hedonic or a matched-model (monthly chaining and replenishment or other overlap) approach to quality adjustment is used (see Chapter 6).

Fresh fruit and vegetables. Article 3(2b) of Regulation No 701/2006 recommends price collection over a period of more than one working week. Prices are probably more variable over time (even over short time spans) than over outlets in the same day. If so, the number of outlets could be reduced to allow a larger number of observations to be distributed over the month.

New cars. Car prices do not usually vary much across outlets for the same model and specification ([35]). On the other hand, there are a large number of models with different prices. One car retailer could easily provide prices for a number of models in the same collection period. As with computers, great care is needed to record all the detailed specifications of a model. This points towards an allocation strategy with perhaps only one retailer per *model* but several models per retailer.

Clothing. For each detailed clothing product, variation in price (in terms of both levels and change) can be great across outlets. There are outlet chains with markedly different price levels. However, prices across outlets in the same chain normally show little variation. If so, allocating the sample to one outlet per major chain and a sample of small independent outlets may prove to be the best strategy, especially for a small country or for each region of a larger country.

Annex 4.2: An example from Germany

In Germany there exists something between the cases set out in Sections 4.4.3 and 4.4.4 and central price collection mentioned in Section 4.4.5. In some chain stores, the prices in all stores (sometimes more than 100) are the same. In such cases, price collection in one store (maybe by well-trained price collectors) is more efficient than price collection in a sample of chain stores. But in that case the *most sold* approach is not appropriate. There is a need to collect more prices per product than with local price collection and to create a chain-specific sample. If such central price collection is combined with local price collection in one elementary aggregate without its own weight (e.g. in Germany taking the clothing chain C&A as the centralised sample and small boutiques as the local sample — both are part of the elementary aggregate 'specialist shops'), then the relationship between central and local price collection must be checked very carefully.

In Germany, for example, the sample fraction for outlets in local and in central price collection should be approximately the same. The number of prices collected for one product in each shop should also be the same. That is not usually the case — in local price collection, usually the (one) most sold product is selected for price collection. In central price collection, a number of product offers — representing the range of goods of the product type — are selected. To avoid a disproportionate sample, explicit weights for the sample of one product in the chain store is created; these 'multipliers' sum up to 1 for each product in the store.

([35]) If price variation due to negotiation by individual customers is to be captured, a sample of customers per outlet/model is needed. However, practical difficulties normally rule out this approach.

5 | Price collection

5.1 Introduction

This chapter covers the definitions, rules and procedures to be applied when observing prices in the HICP, the practicalities of price collection, and the processes of quality assurance and data editing. Usually prices have to be sampled and the procedures concerned normally involve collecting local prices in a sample of outlets in different locations. The sample is designed to be representative of the shopping habits of the population and their purchases within the scope of the HICP, as described in Chapter 4. However, some prices can be collected from central sources, such as utility companies or government agencies that set tariffs. Others may be obtained online or from scanner data.

This chapter covers alternative sources of information on prices; Section 5.5.2, in particular, discusses price collection on the internet, as well as the more traditional methods of price collection. Separate recommendations have been made on the use of scanner data (see the Practical guide for processing supermarket scanner data, Eurostat, 2017).

It does not cover the complexities that occur in some product areas, such as insurance, health services and package holidays. Among the complications not dealt with are tariffs and the bundling of goods and services where, for instance, a customer pays a single price covering both the supply of a mobile telephone handset and a pre-specified amount of calls. These issues are covered in Sections 7.4, 7.6 and 12.6.

The collection and processing of prices must honour the basic concepts and rules underpinning the HICP. The HICP reflects the average change over time in the transaction prices observed, that is, the purchase prices of a representative fixed set of goods and services bought by households.

Price collection should be aligned on the price definition underpinning the HICP. The target for the HICP is the actual prices paid by the HICP target population. However, it is worth noting that price collection methods generally focus on shelf prices in physical outlets or on offer prices given in price lists or on the internet, i.e. the displayed prices of *product offers*. Actual prices may deviate from shelf or offer prices if, for example, the purchaser bargains with the retailer to obtain discounts on large purchases, or if a price is aligned on that in another outlet, or if a seller bargains for higher trade-in prices for used cars and other articles.

The sampling of prices has a geographical, outlet, product and time dimension. Accordingly, multi-stage sampling designs are generally deployed. The geographical and outlet dimensions have been addressed in Chapter 4. The product dimension is also partially addressed in Chapter 4 but will be further dealt with in the present chapter. More particularly, this chapter provides details of how price collectors use non-probability sampling methods to select the particular variety or model of a specified product to be priced in an outlet when they have been given a loose product description by head office.

The time dimension is also covered in this chapter. HICP index numbers each relate to a calendar month, and the index itself is calculated monthly with no backward revisions, apart from those arising from planned changes in HICP methodology, or where there is an error, or the initial figure is marked provisional (see Chapter 10). As prices do not generally remain constant over a month, sampling over time is applied. This involves spreading price collection over a representative period of time, with an extended period of price observation for products whose prices are relatively volatile. For the HICP, there is no obligation to observe prices more frequently than once a month, but the option of extended observation is available and can be used to broaden the sample of prices and to smooth short-term price movements.

Price collection needs to respect the temporal component of the HICP associated with the concept of a fixed basket. Thus, the aim is to collect prices each month for the same representative goods and services, in the same outlets, at the same time of the month.

In this context, an overview of local price collection is given in Chart 5.1 at the end of this chapter. It is presented in the form of a flow chart and shows the different situations facing the price collector and the decisions or referrals to head office for which that person needs to be prepared. The diagram should be seen as an example of good practice in meeting legal requirements: the details are not stipulated by regulation or covered by recommendations.

5.2 Basic legal requirements

This section describes the main legal requirements with regard to price collection. The legal requirements regarding discounts are described in Section 5.3.3.

In Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices, Article 2a provides some general principles. It states:

'The HICP is a sample statistic that represents the change in prices, on average over the target universe, between the calendar month of the current index and the period to which it is compared' and that

'Prices used in the HICP shall be the purchase prices, which are the prices paid by households to purchase individual goods and services in monetary transactions'.

The same article also refers to how a change from a zero price to the actual price, and vice versa, shall be taken into account in the HICP. It also states that the purpose of the HICP is to provide a measure of pure change in prices, unaffected by quality change and that appropriate adjustments are to be made for changes in quality. These issues are dealt with in Section 7.5 and Chapter 6 respectively.

Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, Article 5(3) facilitates the collection of prices by stipulating that retailers must provide prices. It states:

'The statistical units that provide information on products included in household final monetary consumption expenditure shall cooperate in the collection or provision of basic information as required. The statistical units shall give accurate and complete basic information to the national bodies responsible for compiling the harmonised indices'.

Subparagraph 4 of the same article refers particularly to the provision of electronic records:

'On request of the national bodies responsible for compiling the harmonised indices, the statistical units shall provide, where available, electronic records of transactions, such as scanner data, and at the level of detail necessary in order to produce harmonised indices and to evaluate compliance with the comparability requirements and the quality of the harmonised indices'.

Council Regulation (EC) No 701/2006 of 25 April 2006 laying down detailed rules for the implementation of Council Regulation (EC) No 2494 as regards temporal coverage of price collection in the harmonised index of consumer prices establishes rules on the periods for which prices are to be collected and minimum standards for these periods. Article 3 states that:

'Price collection shall take place across at least a one working week period at, or near, the middle of the calendar month to which the index pertains' and *'Where products are known to typically show sharp and irregular price changes within the same month, price collection shall take place over a period of more than one working week'.*

It also states that this rule *'shall apply in particular to the following products: energy products and fresh food, such as fruit and vegetables'.*

Minimum standards for the frequency of index number production, and hence of price collection, are provided for in Regulation (EU) 2016/792 Article 6(1), which states:

'1. Member States shall provide the Commission (Eurostat) with the HICP, the HICP-CT and their respective sub-indices at monthly intervals, including those sub-indices produced at longer intervals'.

Minimum standards for missing prices are provided for in Regulation No 1749/96 Article 6, which states:

'1. Member States shall produce HICPs using the observed prices of the target sample.

(a) Where the target sample requires monthly observation, but observation fails due to non-availability of an item or for any other reason, estimated prices may be used for the first or second month but replacement prices shall be used from the third month.

(b) Where, exceptionally, the target sample requires observations less frequently than monthly, estimated prices shall be used for those months where observed prices are not required. Estimated prices may also be used on the first occasion on which price observation fails. Where observation fails for a second consecutive occasion, replacement prices shall be used.'

2. Where, in the circumstances referred to in this Article, replacement prices are not available, estimated prices may continue to be used, provided that the extent of their use is limited to a level appropriate for achieving comparability.'

Regulation No 1749/96 Article 2(12) states that:

'Previously observed prices shall not be regarded as estimated prices unless they can be shown to be appropriate estimates.'

The focus of the above articles is on procedures for using *estimated* (i.e. imputed) prices in cases where it proved impossible to observe a price directly, rather than price collection as such.

There are no HICP regulations or official guiding principles relating specifically to observation (non-sampling) errors during price collection, but Regulation No 1749/96 Article 9(d) does include a requirement to carry out appropriate checks on price observations and estimates. It states:

'Member States shall … establish and maintain a clear set of information on the target sample and shall carry out checks of price observations and price estimates sufficient to ensure compliance with this Regulation.'

The detection of outliers and errors, such as those attributable to errors in the price collection, is part of the process of checking and correcting inaccurately observed prices.

It is important to verify, as far as is operationally feasible, that the prices entering the HICP are correctly observed and recorded. Price validation checks need to be carried out in good time because, in a dynamic retail environment, prices in shops can change between visits and the HICP compilation schedule is very tight. This chapter ends with an overview of some suitable quality assurance and data editing methods that can be deployed.

In the context of price collection, reference is sometimes made to a distinction between data sources that are *primary* and *secondary* data sources. Primary data sources include local price collection from price tags and outlet staff in the field. Prices can be collected by visiting in person, by telephone or by checking vendors' web sites, catalogues, or price lists (electronic or paper-based). Secondary data sources include administrative sources and the average revenues per unit sold, as shown by scanner data, from which prices can be derived.

There is an intermediate grey area where the distinction is less clear-cut. For instance, it is unclear whether a tariff for the supply of a utility and the associated detailed figures on sales, obtainable from a regulatory authority, is a primary or a secondary data source. While the regulatory authority is a secondary source, it has access to information obtained directly for regulatory purposes from the utility company, the primary source.

Two important considerations when using secondary sources are whether prices correspond to the price definition used in the HICP, and whether they come from a trusted and neutral source with no interest in misreporting, pertain to the correct period of time, and are verifiable. Due consideration must be given to checking secondary sources to confirm that they meet these conditions. It is not unreasonable to expect data obtained from a regulatory authority to be subject to quality assurance. However, such data are focused on the needs of the authority as regards timing, detail and so on, not those of the HICP. One of the main attractions of using secondary sources is cost-effectiveness and, in the case of regulatory authorities, for instance, the possibility of obtaining large quantities of quality-assured data from one source.

5.3 Principles

The following five principles express the general ideas that should guide index compilers in developing price collection strategies:

1. The fixed basket

2. The definition of a price

3. Discounts (price reductions)

4. The timing of price collection and of entering purchase prices into the HICP

5. Frequency and period of price collection periods: volatile prices.

5.3.1   Principle 1: The fixed basket

An underlying principle of price collection in the HICP is the fixed basket approach. The HICP is described as a Laspeyres-type *pure price* index. The reference to a pure price index refers to the fact that it is only the changes in prices between the current (comparison) period and the price reference period that are reflected in the HICP (see Chapters 2 and 8). Comparing prices between months on a like-for-like basis is an underlying principle of the HICP and inflation measurement. The HICP's fixed basket approach relates to holding consumption segments fixed over time (see Chapter 4), while products might be replaced where necessary or desirable, applying quality adjustment if the price-determining characteristics of the replacement differ from those of the product it has replaced (see Chapter 6).

Central to this aim is the concept of a product offer. A product offer is an observable entity comprising a specific model/variety of a single good or service (product) offered for purchase at a stated price in a specific region, location and point in time (an outlet, in the case of local price collection in a shop). The product specifications provided by the central statistical office may be rigorously stipulated or loosely stated (see Chapter 4 and Section 5.4). It is paramount to ensure that the priced product offers are representative and that the recorded monthly price movements within each consumption segment of the HICP reflect only price changes.

Under stable market conditions it is advisable to collect prices that relate to the same product offer as in the preceding month. The same product offer should be priced in subsequent matching periods. In the case of local price collection, that means collecting the prices of the same products, in the same shops and at the same point in time as in the previous period. With central price collection, it means collecting the prices of the same representative goods and services offered by the same suppliers in the reference month. This makes it necessary to record any additional information available on product characteristics, to ensure that the same specific product continues to be priced (see Section 5.4).

For both local and central price collections (see Section 5.5 below), it can be particularly challenging to identify a unique product offer if prices are being collected in a subsequent period by a different person who may be less familiar with the products and outlets. This is another reason why an adequate description of the product offer being priced in each outlet should be recorded, so that it can be uniquely identified at subsequent pricing. This description may be more detailed than the version of the product offer specification used for sampling, particularly if loose product specifications are used. In some instances, the use of bar code values (international article numbers, EAN), photographs and the recording of audio descriptions can be an effective way of doing this. For instance, photographs and audio recordings can be very helpful when collecting garment prices. However, these other methods are not always free of problems, such as the reuse of EAN/bar codes.

Detailed product information is also required to identify changes in quality when there needs to be a product offer replacement. This occurs when the specific product offer being priced is no longer available or no longer representative. For instance, the specific outlet concerned may no longer sell the product, or the product itself may no longer be generally available in outlets, because it is no longer produced or marketed. If no replacements were made when product offers disappeared, the sample of product offers and prices would diminish and could become increasingly unrepresentative.

When a product offer disappears and is being replaced, the main price-determining characteristics must be listed to inform the choice of replacement and any necessary quality adjustment. It should be borne in mind that similar models (with different article numbers) may differ in ways that do not matter to consumers and do not affect the price (such as the exact position and size of a brand name label), so it would be pointless to record such differences. But checks need to be carried out at each subsequent price collection to identify any modifications that could affect the price of products which appear unchanged. For instance, the same model number may be in use, but it may be discovered on enquiry that the detailed features have changed. For fruit and vegetables, weight, quantity information and packaging (i.e. whether the goods are loose or pre-packed) should be part of the product specification. This also applies to a range of other products such as meat, fish and bread. This information is needed

to adjust the nominal price in the price reference period of the new or replacement product, to make allowances for any change in quality (including quantity). It is important for price collectors to check pack sizes regularly, as it cannot be assumed that they never change.

In the event of changes in product specifications, prices should be treated in accordance with the rules on quality adjustment set out in Regulation No 1749/96, Article 5. How these rules are applied in practice is the subject of Chapter 6.

Price collectors can have a crucial role in the procedures for replacements and quality adjustment — how vital that role is depends on whether loose or tight product specifications are used (see Section 5.4 below). Price collectors have more influence on the reliability of the HICP when loose product specifications are used, as these leave them more discretion to choose what product offers they price. Where a replacement product offer has to be found, it often falls to the price collector, with guidance from the commodity and product experts at head office, to find the most suitable replacement product, bearing in mind the need to avoid near-obsolescent products and products that are not representative of current purchasing habits. Price collectors need clear instructions on how to do this. Similar considerations apply when prices are collected by head office.

Identifying changes in characteristics

In some cases, the price-determining characteristics of products appear superficially to be exactly the same as in the preceding month, but prove on enquiry to have changed. For instance, this may be the case where there has been a small reduction in the pack-size which will only be obvious by looking at the small print at the side of the packet or where certain fruits, such as berries, are sold by basket and not by weight.

In such cases, price collectors should read the information given on the packaging, weigh the basket or ask shop staff whether the amount of fruit in the basket has changed. Before pricing, the price collector should always first check the product description on the price collection form — which should include all price-determining characteristics — with the description on the article sticker. If the sticker does not provide the full description, shop staff should be asked to provide the missing information. It is impossible to be prescriptive about what follow-up questions should be asked, but they should focus on confirming the price-determining characteristics.

Replacement strategies

When choosing replacement product offers, one of two main strategies can be adopted, but the decision may not always be clear-cut. The two main strategies are: (i) to replace the product by the *most similar product model,* or (ii) to replace it by *the product model most representative of current purchases by households* (see Chapter 6). Section 4.4.4 discusses the strategies that can be used for the initial sampling of product offers, i.e. the product offers *most sold* or those that may be expected to *last longer.*

Replacing the product by the one *most similar* to it reduces the role of quality adjustment, as the more similar a replacement product offer is the less the price-determining characteristics will have changed. However, the disadvantage of this strategy is that the sample of product offers in the consumption segment may become increasingly unrepresentative, as the replacement product may be less likely to be typical of what is currently being sold. Replacing the product by another that is *most representative* resolves this issue by keeping the sample up-to-date and relevant, but will result in the need for more quality adjustment. The HICP regulations offer no detailed advice on this issue. However, one of the main legal requirements of the HICP is that it should represent the average change in prices over the target universe. Statisticians should weigh up the pros and cons of each approach to replacing product offers. In so doing, they need to take into account:

- the dynamics of the market, most particularly the rate of product development,

- the capacity and capability of the statistics office to adopt satisfactory quality adjustment procedures, and, most importantly,

- the need to ensure that there is a representative sample. (See Chapter 4.)

The point to note in this chapter is that the price collector needs to be given clear instructions on which rules to follow when choosing a replacement and which information to record when so doing.

Generally, product offers in the sample should be replaced when they are no longer representative, not just when they can no longer be found in outlets. This is particularly important for high-tech products, which are subject to

rapid technological development and a high replacement rate of models. Quality adjustments and replacements are discussed in depth in Chapter 6.

5.3.2   Principle 2: The definition of a price

Regulation (EU) 2016/792 Article 2 provides a definition of price. This states in clauses (2) and (4) respectively:

'2. Consumer prices' means the purchase prices paid by households to purchase individual products in monetary transactions'.

4. 'Purchase price' means the price actually paid by the purchaser for products, including any taxes less subsidies on the products, after deduction of discounts from standard prices or charges, excluding interest or services charges added under credit arrangements and any extra charges incurred as a result of failing to pay within the period specified at the time of purchase'.

The above definition broadly follows the concept of the purchaser's price as defined in the European System of Accounts (ESA) 2010.

The prices used to compute the HICP are the transaction prices agreed at the time of purchase between households and retailers of goods and services within the scope of the index. The transaction price is defined to include sales taxes such as Value Added Tax (VAT) less any subsidies (e.g. subsidised prices charged by government) and allowable non-discriminatory discounts.

The overall position is that expenditure and prices included in the HICP should relate to payments made to purchase goods or services. The fact that the prices paid may be subsidised is of no consequence (examples of subsidised prices are given in Section 12.1 Health, education and social protection). Similarly, the price recorded for the HICP should be net of reimbursements, i.e. net of any payments made by the vendor of the good or service to the purchaser — whether they are an outlet, a government agency or some other vendor — as a consequence of purchasing a good or service. Reimbursements must be available to all potential customers, with no special conditions attached, if they are to be considered non-discriminatory and to fall within the scope of the index. For example, savings from using a credit card which entitles the user to a reimbursement when the monthly credit card bill becomes payable should be disregarded, as this is discriminatory. Similarly, a store card offering a refund on a purchase, either directly on the item purchased itself, or in the form of credit towards a subsequent purchase, should be disregarded.

Supplementary interest or service charges associated with consumer credit arrangements are excluded from the price, as are additional charges arising from failure to pay within a stated period, e.g. when using a credit card at the time of purchase. These latter charges are not part of the purchase price and should be excluded. Services incurring unavoidable charges that are not part of the basic advertised price (such as a delivery charge for large household appliances or furniture) and which are either compulsory or which most customers choose to use as a *discretionary* service, may be treated as an inseparable bundle of a good and a service and thus as a single product (see Section 7.6 on the treatment of bundles).

Tips for services, e.g. in restaurants, should be included in the purchase price if the service charge is shown in the price list as a standard component of the total price to be paid and is itemised in the bill. For example, in some restaurants there is a non-discretionary service charge for parties of, say, six or more people dining together. The service charge should relate to the product offer being priced and should exclude charges for any additional services not specified in the product offer. Non-compulsory tips or gratuities are gifts that fall outside the scope of the HICP.

Prices are thus defined in the HICP as the prices that purchasers pay, that is, the acquisition prices. Acquisition prices are what consumers actually agree to pay when they purchase goods and services to satisfy their consumption needs. As previously stated, price collection methods generally focus on shelf prices in physical outlets or offer prices in price lists or on the internet, i.e. the advertised prices of products offered for sale. This deviation from the target measure is often admissible, but where there is any doubt, the price collector should preferably check that the offer price is the price most commonly paid.

By convention, individually negotiated prices do not fall within the scope of the HICP, although priced quotations given by builders, decorating services and service providers for specific jobs are covered, subject to a representative sample of such quotes being drawn.

5.3.3 Principle 3: Discounts (price reductions)

Discounts fall within the scope of the index if they:

- are non-discriminatory

- apply to an individual good or service

- are known to the consumer in advance, and

- are given at the time of purchase or very soon after the purchase is made.

Commission Regulation (EC) No 2602/2000 of 17 November 2000 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of price reductions in the Harmonised Index of Consumer prices [36] provides principles for the treatment of discounts, that is price reductions, in the HICP. Article 2 states:

> *'Unless otherwise stated purchaser prices used in the HICP shall in general take account of reductions in prices of individual goods and services if such reductions:*
>
> *a) can be attributed to the purchase of an individual good or service; and*
>
> *b) are available to all potential consumers with no special conditions attached (non-discriminatory);*
>
> *c) are known to the purchaser at the time when they enter into the agreement with the seller to purchase the product concerned; and*
>
> *d) can be claimed at the time of purchase or within such a time period following the actual purchase that they might be expected to have a significant influence on the quantities purchasers are willing to purchase.*
>
> *In particular, reductions in the prices of individual goods and services which are likely or expected to be available again at standard prices or are available elsewhere at standard prices shall be taken into account in the HICP. Standard price means the price without any conditions or qualifications and not described as a special price.'*

In short, the above article states as a main principle that non-discriminatory discounts, i.e. price reductions available to all consumers, without special conditions, are to be deducted from prices used in the HICP. The discount offered or the special-offer price displayed must refer to a particular defined product and must be visible to the consumer at the time of purchase. This category includes *instead of* prices, where the standard price is replaced by a special price. The existence of a true discount price can usually be substantiated, e.g. where the consumer and the price collector can see both the standard and the reduced price displayed.

Before designating a price as a *sale* price, care should be taken to ascertain that it represents a genuine discount and has not been assigned to shop-soiled or damaged goods, products close to their expiry date, or items that are similarly perceived as being different in quality from the corresponding products that are normally on sale.

The non-discriminatory stipulation requires some judgement. Reduced prices offered to pensioners for public transport is an example of a discount available to identifiable sub-groups of the population. Discounts of that kind should enter the index calculation if deemed significant.

However, bonuses and free gifts are not universally treated as discounts, that is, they should not be deducted from prices in the index, unless they are likely to have influenced consumer behaviour, i.e. they provide an effective inducement for the customer to purchase the good or service in question (see rule 3 below).

The treatment of discounts in the framework of the HICP is shaped by the following three criteria. The treatment should:

- represent a *practicable* solution.

- ensure *equal solutions* independent of data sources in the HICP.

- ensure, to the extent possible, *consistency* with Article 2 of Regulation No 2602/2000, referred to above.

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[36] OJ L 300, 29.11.2000. p. 16.

In this context and against a background where discounts have become more prominent and where a wider range of data sources for prices are being used (including scanner data and web-scraping), five general rules can help to guide the index compiler. These do not necessarily form part of a regulation, but they can provide guidance for applying regulation rules in practice.

Rule 1: General principle. Price reductions (i.e. discounts) should be taken into account in the HICP as long as they are applied to an individual good or service and are known to the purchaser at the time the purchase is made.

Rule 2: Discriminatory discounts. Discounts available only to a restricted group of households may be disregarded unless they are expected to affect consumer behaviour and have a noticeable effect on the HICP published indices and inflation rates. They are likely to have such an impact if they are available to a significant proportion of people or households and the associated expenditure is relatively high in percentage terms. Where such reductions are included, they should be sampled according to their relevance.

Rule 3: Inducements. Inducements in the form of extras may be disregarded if the value to the consumer of the inducement (normally taken to be the retail price of the inducement if purchased) is insignificant and has little impact on whether a potential customer makes a purchase. The market value of the inducement may be deducted if known, but it should then be added back if the offer is withdrawn. Where such inducements are included, they should be sampled according to their relevance.

Rule 4: Rebates. Rebates or refunds should be taken into account only if they are linked to the purchase of an individual product and granted within a period of time after the actual purchase such that they are expected to have a significant influence on the quantity purchased. Rebates should be treated in the same way by the HICP and the national accounts. The latter point is particularly pertinent for some services provided by government or state agencies. For example, where the consumer pays in part for health services, the prices should be net of direct refunds made as a direct consequence of the individual purchasing the service in question. However, payments to households in the form of assistance to reduce the net cost of household expenditure by increasing household income are considered by the System of National Accounts (SNA) to be social benefits in cash and income transfers from government to households. They fall outside the scope of the HICP. Housing allowances payable to tenants of rented property are an example.

Rule 5: Credit and payment arrangements. Credit and payment arrangements involving interest, service charges or extra charges incurred as a result of failing to pay within the period stated at the time the purchases were made should be disregarded. These charges are not part of the purchase price.

Table 5.1 below uses examples to provide more detailed guidance on forms of reduced prices in HICP according to Regulation No 2602/2000.

Table 5.1: Guidance on treating reduced prices in the HICP

Form of price reduction	To be reflected in the HICP	Not to be reflected in the HICP
Rules from the Regulation		
1 When the reduced price can be linked to an individual good or service	1 - 3 to be fulfilled in combination	
2 When the reduced price is available to all potential consumers		
3 When the reduction is known to the purchaser at the time the transaction takes place		
4 When the reduction can be claimed at the time of purchase and it is expected to have a significant influence on the quantities sold	X	
5 Inducements which are not significant		X
Rules from the guidelines		
6 Stock clearing sales prices if no specification changes are identified	X	
7 Closing-down sales prices if no specification changes are identified	X	
8 Seasonal sales	X	
9 Goods which are in end-of-range or line sales		X
10 Damaged, shop-soiled or defective goods or stock purchased for the sale		X
11 Goods close to their expiry date		X
12 Prices which include zero-interest loans		X
13 Prices which include positive interest loans		X
14 When the price for more than one piece is lower than the price for one piece		X
15 Free product B provided with purchase of product A		X
16 Prices in connection with money off coupons		X
17 Lower price for a restricted group of persons		X
18 Deposit for money back bottles	X	
19 Deposit included in the price of a new car if the old car is destroyed		X
20 Loyalty rebates		X
21 Prices in connection with loyalty cards		X
22 Incentive schemes to replace old products by new ones (e.g. cars)	X	
23 One-off rebate in next year's bill		X

Each case that arises needs to be considered on its own merits and tested against the rules of Regulation No 2602/2000 and the accompanying guidelines. Examples of discriminatory and non-discriminatory price reductions are given below.

Advertised prices in *stock-clearing sales* and *closing-down sales* should be taken into account if no specification changes are identified, as the prices are non-discriminatory and apply to individual goods (rule 1).

However, *discount cards* which are only available to people who have joined an organisation such as a trade union and which entitle the holder to discounts at certain shops are considered discriminatory. They require the shopper to perform a specific action before shopping, subject to specified terms and conditions, and are not associated with an identifiable intrinsic sub-group of the population, such as pensioners (rule 2).

Cash-back discounts should be disregarded (rules 3 & 4). For example, credit cards from banks are *not* discriminatory, as they are available to the adult population in general. But any cash back or points accruing from a purchase which can then be used to obtain free gifts or cash backs on purchases are associated with the use of the credit card and are not linked with the purchase of an individual product. The same applies to store cards.

Similarly, any annual fee for the use of the card or interest charges incurred are not part of the purchase price of a product (rule 5).

An inducement should be deducted from the purchase price only if: it has monetary value for the consumer, is associated with a particular sale, and is large enough to influence whether a purchase takes place. Judgement is required, and perhaps some market research or discussions with the retailer, to ascertain whether an offer by a retailer will influence shopper behaviour. Insignificant inducements should be ignored.

An example of what may be considered an insignificant inducement is providing a free tank of petrol when a new car is purchased. While the petrol may have considerable monetary value, it is unlikely to be significant compared with the price of a new car. Moreover, it is impossible to assess whether such an offer increases sales. But if five litres of petrol were provided free for every 10 litres purchased, that would probably be a major incentive for drivers to buy their petrol at the petrol station advertising the offer. This would be an example of a significant inducement and would therefore fall within scope of the HICP (rule 3).

5.3.4 Principle 4: The timing of price collection and of entering purchase prices into the HICP

Article 2 of Commission Regulation (EC) No 2601/2000 of 17 November laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the timing of entering purchaser prices into the Harmonised Index of Consumer prices ([37]) states that:

> '… *prices for goods shall be entered into the HICP for the month in which they are observed. Prices for services shall be entered into the HICP for the month in which the consumption of the service at the observed price can commence.'*

This has a bearing on the collection and treatment of prices for services, e.g. on the treatment of package holidays and airfares, concerts and season tickets for football, which are usually purchased some months before the holiday, concert or football season. This has an impact on the scheduling of price collection and on the product offers being priced.

Regular price collection to a fixed timetable is an important aspect of price collection related to sampling (see Chapter 4). The interval between successive price collections from each retailer — whichever price collection method is used — must be kept constant by collecting prices at a set time each day, week, month or quarter, e.g. the second Monday of each month or the third week of every month. This is regardless of the frequency of price collection and is especially important when collecting prices for products with volatile prices (see the next section).

5.3.5 Principle 5: Frequency and period of price collection periods: volatile prices

The HICP recognises that special arrangements may be needed for products whose prices tend to be volatile over time.

Regulation No 701/2006 Article 3 states that:

> '*Where products are known to typically show sharp and irregular price changes within the same month, price collection shall take place over a period of more than one working week'.*

This rule applies in particular to:

- energy products; and

- fresh food, such as fruit and vegetables.

The HICP legal framework does not set out all the practical details of implementation. This enables individual EU countries to choose the approach that best suits them. The important point is that the average prices should be

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representative of the average price for that month, i.e. they should be based on a dense enough sample over time to deal with price volatility and should also be representative of sales periods.

How the price collector deals with volatile prices depends on the nature of the volatility. Thus, if prices are volatile due to regular changes over the week — for instance, peak prices for restaurant meals could be on a Saturday, when demand is particularly high, with lower prices on other days of the week — then collecting prices on the same *representative* day of the week should prevent artificial volatility in the index as long as the price pattern remains stable. On the other hand, if price volatility is irregular, then averaging of daily prices over an extended period may be warranted. An example is retail petrol prices, which can change daily in response to fluctuations in the price of crude oil.

5.4 Product descriptions and product specifications

To compare prices on a like-to-like basis from one period to the next, the price collector should record all the additional information needed to ensure the unique identification of the product offer in a given outlet (see Section 5.3.1). The product characteristics that significantly determine the product price, particularly when loose item descriptions are used, and which are not part of the general product offer specification, should be recorded (see also Chapter 4). In the latter case, this information is helpful when a product with a relatively loose specification is first introduced into the HICP and an operational decision is being taken about what model or variety of a product should be priced in a particular outlet, i.e. the specific product offer. It is also needed to determine what allowances need to be made for quality changes if the product characteristics change as a result of to a change in the manufacturer's specifications or the introduction of a replacement product offer with different characteristics. Product information can also help the price collector assess whether a model (product offer) is likely to be available for pricing over a reasonably long period, as well as whether it is typical of what is sold. More generally, product information can help the price collector identify the same product offer in consecutive months.

As regards product specifications, there are no firm rules on the use of *loose* or *tight* product specifications to suit price collection, but certain considerations come into play.

Specifying a TV set of a particular brand and model is an example of a tight specification, while *TV sets,* which allows for all kinds, is a loose specification. Naturally there are a range of possible options between the two opposite ends of the spectrum (extremely tight and extremely loose). An intermediate option in the TV example might be to specify the most important price-determining features, which in this case might be a TV of a particular screen size, with ultra-high definition (4K-ready).

Clothing and furniture often require loose specifications because the existence of so many brands, styles and models can mean that different outlets rarely sell exactly the same range of products unless they are part of a retail chain.

Chapter 4 on sampling discusses in more depth the issue of loose versus tight item specifications.

It is good practice to test product specifications by piloting the collection of new product offers a few months before they are included in the calculation of the HICP. This will allow the detection and correction of errors in the wording of the product specifications, to ensure that local and head office price collectors and retailers completing questionnaires and the like have understood the specifications correctly.

An important consideration, particularly relevant to local price collection, is that loose specifications give price collectors a more important role and more influence, as they have greater discretion over what to price. This means placing greater reliance on them. However, loose specifications can broaden the range of product offers in the sample and increase the sample size achieved, particularly if there is a wide range of product types in the marketplace, i.e. if the market is relatively diverse and outlets do not stock all brands and varieties. Naturally, tight specifications are of limited use if the specified product can be found for sale in a small number of retail outlets only, or if it is only available infrequently in the outlets surveyed.

5.5 Price collection methods

5.5.1 Local and central price collection

While HICP regulations define the set of prices to be covered by the index and also the price concept, the regulations are not prescriptive about data sources. They leave it to individual countries to decide on the appropriate sources for gathering prices and the sampling methods to be used. This is because the most appropriate sampling and survey methods and the best data sources for the HICP price survey depend on local circumstances. These include the structure of retailing in terms of the characteristics of outlets, their geographical spread and the range of goods and services available to purchase. Note that most of the best practice referred to in this chapter applies equally to local and central price collection.

As regards *local price collection,* consideration must be given as to how best to collect prices with regard to efficiency, accuracy and representation of consumers' purchasing patterns. Replacement strategies and the application of quality adjustment methods can also be a consideration. For example, more complex and data-intensive quality adjustment methods, such as hedonic methods, are applied centrally because they require highly technical skills and relatively large and detailed data sets that go beyond what many local data sources can provide.

For many kinds of products, prices are collected locally by price collectors visiting a sample of retail outlets — either selected by the head office or coordinated by it using a prescribed sampling scheme — and recording the current price of a sample of product offers. This approach is referred to as *local* price collection (see Section 5.8.1). The products to be priced are usually selected by head office, but there may be some leeway in the exact characteristics, such as the brand or specific product model to be priced.

The use of hand-held computers or tablets for local price collection makes it easier to gather prices in the field in real time, improves quality assurance and increases the scope for better quality control by head office. It also obviates the need to copy prices from paper to computer, which is inefficient and avoids the associated risk of transcription errors. Local price collection can be costly, and consideration needs to be given to the most efficient way of collecting prices while also ensuring accuracy and proper representation of consumers' purchasing patterns. There are other options which are less expensive (see below).

Despite the cost, there are also advantages in local price collection. In particular, regular visits to the shops in their price collection area mean price collectors can physically check that the same product offer is being priced from one month to the next, and they will also be better informed about local retailing. They can raise queries and ask retail staff questions that might not appear relevant or be feasible in the same timescale if they were doing this at a distance. Such questions might include, for instance, whether there have been hidden changes in product characteristics, whether the product offer being priced is still representative, and whether staff think a missing product is likely to be re-stocked.

Conversations with retail staff also make it easier to put follow-up questions straight away. The knowledge and expertise that local price collectors gain can also be used more generally, benefiting the continued development and relevance of the HICP. For example, local price collectors can inform their head office about newly significant products found on retailers' shelves and about new shopping centres or outlets. Such information can be used when reviewing the HICP basket of goods and services priced and the outlet sample.

Local price collection can be outsourced to a private company for financial or practical reasons, although most statistical agencies do this work in-house. Local price collection is a specialist activity requiring special skills. Outsourcing enables statistics agencies to exploit the price collection expertise of market research companies and others, and to focus on more familiar statistical data-gathering exercises, thus reducing average unit costs and using their professional skills in the most effective way. However, outsourcing depends on having effective and well-managed contracts.

Collecting prices centrally, without visiting local outlets, can offer a good alternative to local price collection. Often it is the only feasible method, particularly for some services, such as health, education and social services, which, in most countries, are provided almost exclusively by government institutions or public bodies. Central price collection can also provide the best option for services like utilities and public transport, where prices are set nationally or regionally by the public or private sector supplier, and it is the only option where there are no outlets as such (see Section 5.8.2).

Prices set centrally may change infrequently and at pre-determined times of the year, making price collection relatively less laborious. However, statistical offices should avoid making unwarranted assumptions that there have been no price changes between one collection period and the next. In principle, central prices can also be collected centrally in any situation where a retailer advertises prices online, for instance, or from a retail chain with centralised pricing and where prices can be obtained from a central source.

Centrally collected prices are usually obtained by postal enquiry, telephone, fax or email or directly from websites. It is not usually necessary to visit the head office of the retailer or service provider on a routine basis, although it is advisable to maintain regular contact, e.g. by email. Where retail chains claim to set prices centrally for all their outlets, the price collector should check that there are no local variations in prices, and that the central pricing policy has not changed since the last time prices were collected. The head office of the retail chain should be asked to confirm regularly that prices are set centrally, and independent checks should be carried out where possible, e.g. informally when doing family shopping. If the prices advertised by a retailer online are, in reality, different from those charged in that retailer's shops, then online purchasing should be treated as a different outlet-type and should be placed in a different elementary aggregate. Prices can also be collected from publicly available price lists, on websites for example, provided that these lists are up-to-date and accurately reflect the price a customer would pay when visiting a physical outlet. The main challenge with these sources is validating the prices by reference to an alternative source. Setting up arrangements to compare prices quoted in price lists from central sources with those in a sample of outlets rather undermines the benefits of central price collection.

It should be noted that consistency issues arise when combining price data from different types of outlets, that is, different channels for purchase. In these cases, it is important to have a properly balanced sample of prices from the whole range of outlet channels that accurately represent the purchases of the target population. Constructing separate elementary aggregates for each data source — where the latter represents different outlets or outlet-types — and aggregating the elementary aggregates using explicit weights relating to the respective turnovers can help to ensure a balanced sample, but may not entirely resolve the problem.

For example, internet prices from a retail chain's website and the corresponding in-store prices, which may be different, would ideally need to be weighted according to the respective values of sales via the two channels. Moreover, product offers representative of in-store sales may not be representative of internet sales, and vice versa.

There are several considerations when deciding whether to use central or local price collection. An assessment has to be made as to whether there is a central source of relevant information, such as a public utility provider or a government agency, with a pre-established list of products, prices and purchase conditions that has been established centrally by the supplier or by government. In many cases, the service provider may provide a full price list or tariff from which prices can be extracted, either in their entirety or on a sample basis.

If there are a very small number of prices, sampling may not make sense or may be unreliable. For example, no sampling would be involved if an electricity tariff simply consisted of a standard standing charge for service provision and a standard charge per kilowatt of electricity used that was the same for all customers, regardless of location and varied only with total usage. See Section 7.4.

Other prices may be obtained centrally, either for convenience or to maintain a representative sample, where this mode of purchasing is increasingly used.

The general issue of sampling is addressed in more detail in Chapter 4.

5.5.2   Internet price collection

The internet is a major price collection source for the HICP. For some time, EU countries have been using it to observe prices centrally, instead of sending price collectors to physical outlets. However, changes in households' purchasing habits, with more and more purchases now made online, reducing visits to physical stores, have prompted countries to review their use of the internet for data collection. EU countries increasingly include online outlets (even when physical stores exist in parallel) as a separate outlet-type in their index compilation systems. They are developing their price collection methods to reflect this change in the market.

Consequently, the internet today has two roles in price collection:

- Firstly, it is an important outlet-type where consumers actually buy goods and services.

- Secondly, it is a significant source of price information on goods and services bought by consumers elsewhere (i.e. in other physical or non-physical outlets).

It is important for price statisticians to know the role and type of prices observed on the internet. The first type of price relates to transactions that are *actually undertaken* on the internet. These prices from internet outlets should enter the HICP in proportion to the underlying transactions' market share. The second type of price may be used to replace the prices collected in the field in physical outlets. The main advantage of collecting prices from the internet is that it is generally much cheaper than collecting prices by visiting outlets in person. One website may even show both sets of prices charged when buying goods at the physical outlet or through other traditional channels (catalogues), and the prices charged when purchasing online, as well as special online-only offers.

Price collection from online retailers shares certain features with traditional price collection. Member States need to check that the prices collected are in line with the HICP price concept. Also, as visiting an online retailer's website should be seen in some sense as similar to going to a physical store, internet price collection should be done in accordance with the national laws and practices applicable. For example, retailers could be informed in advance that they are part of a sample and that the country is planning to collect prices for the HICP, if that is the national practice.

What is more important is that the internet era brings new opportunities and challenges for price collection. The opportunities are linked to the digital nature of the internet, which makes automated price collection possible. This in turn enables a larger amount of data to be captured and the frequency of data collection to be increased. These factors have the potential to improve the quality of the HICP. The challenges are linked to managing increasing amounts of data, retailers' new pricing strategies, blurred national boundaries, the inclusion of the sharing economy [38], and the complexity of the internet as a potential data source. Another feature of the internet is its propensity for rapid change. EU countries are currently developing strategies and technologies to address these challenges.

Prices can be collected from the internet using the traditional method of central price collection, i.e. statisticians visit web pages to observe the prices of a sample of products considered to be representative. However, the internet also offers promising new options. Some EU countries are using ready-to-use commercial internet data extraction websites and software tools, which provide easy access to web-scraped internet price data. Moreover, many countries are developing web-scraping tools tailored to specific HICP requirements. Such tools can collect large numbers of prices for a wide variety of online products and automatically feed them into structured datasets, using web-crawling software.

Collecting prices online involves a number of technical and practical issues that do not affect traditional price collection in physical outlets or are less important in that context. Developments in this area are ongoing and appropriate solutions have not yet been found in all cases. The issues concerned have to do with technical innovations used by retailers in the area of pricing strategies, and with the globalisation of online retail. Some examples are outlined below.

As online outlets can record all visits and purchases by using cookies, monitoring IP addresses or requiring registration, they can target their marketing, with different products and prices for different customers. For example, a price collector surfing from one online store to another might be offered a reduced set of products or prices adjusted in line with the search carried out in the first internet outlet, as relevant information might have been saved by way of cookies.

Another technique used by online retailers is *dynamic pricing* by which retailers automatically and continuously change their prices in the light of current market demand, identified consumer profiles, competitors' pricing and other external factors in the market. This is already common practice in several market segments, such as travel, entertainment, electricity and public transport. As online retailers are increasingly using dynamic pricing, the frequency of price collection and the methods used also need to be adapted to online stores' pricing policies.

Online outlets can also use geo-blocking and other geographically based restrictions to prevent customers from other countries from making purchases. And this may only become apparent once the would-be customer reaches the final step of entering payment details. While cross-border purchases should be included in the HICP of the

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[38] According to Wikipedia, the 'sharing economy' is an umbrella term with a range of meanings, often used to describe economic and social activity involving online transactions. The term was originally used by the open-source community to refer to peer-to-peer-based sharing of access to goods and services. It is now sometimes used in a broader sense for any sales transactions conducted via online marketplaces.

country where the products are delivered (see Section 7.2 on the treatment of cross-border internet purchases), the prices of products that are not available for purchase in a given country must be excluded.

The Recommendations in Section 7.2 give additional guidance on the need to include unavoidable extra costs incurred solely through the purchase of an individual product. Delivery charges, booking fees and credit/debit card fees are typical examples.

The issue of internet purchases and their implications for the HICP is constantly developing, and updates to this section in the manual can be expected.

5.6 Missing prices

As regards prices of product offers which have become unavailable, it may not immediately be possible to find out whether the products concerned are only temporarily unavailable. If a product offer is permanently unavailable, this may be because the outlet has decided to stop stocking it or because the supplier no longer supplies it, perhaps because it is no longer manufactured. The price collector plays an important role in collecting information and should be encouraged to identify the real causes for missing prices.

In situations where prices cannot be observed although the product is not out of season, Article 6 of Regulation No 1749/96 applies. This means that *estimated* prices may be used for the first and second months for which the product offer is unavailable, but replacement product offers should be used from the third month [39].

What action needs to be taken by the price collector depends on whether the product offer is temporarily unavailable or no longer stocked. A price should be recorded only if the product offer is in stock and for sale. If the article is not on the shelf but the shelf indicates a price, the price collector should not record the ticket price. Instead, he or she should record that the product offer is not available, ascertain and record for head office whether it is only temporarily unavailable, and, if it is to be re-stocked, whether it is expected to sell at the price currently displayed on the ticket. Head office can use this information to decide how best to estimate the missing price, e.g. by carrying forward the previous month's price.

The price collector's role in choosing a replacement product offer will depend on whether tight or loose item specifications are used.

The purpose of the Regulation rule is twofold:

- To highlight that the use of price imputation techniques should be kept to a minimum.

- To guarantee comparability between HICPs by establishing a common standard for dealing with missing observations and their replacement.

Where a product is temporarily missing, the price collector need do no more than note this on the return sent to head office and then check in the *next* price collection period whether the product is in stock or temporarily or permanently out of stock. Head office will then impute a price, or in rare circumstances carry forward the price if this can be shown to be an appropriate estimate (see the example above).

The price collector faces a bigger challenge if the product offer is no longer available in the outlet or has been out of stock for 2 consecutive months. In both instances a replacement product offer needs to be found. If the product offer is only temporarily absent, a replacement needs to be made in the third month. As regards prices observed at less frequent intervals (e.g. quarterly or annually) because they are known not to change at monthly intervals, estimated prices can be used only on the first occasion on which price observation fails. However, price collectors should make every attempt to avoid such situations by anticipating when prices are unlikely to be available. They can do this by checking with the store manager, observing when the stock on display is running low, and asking whether the product will continue to be sold. When a replacement has to be made it is important to have operational rules on product replacement, e.g. on whether to choose the product that is most similar to the one

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[39]   In practice an imputation can be performed by leaving out the missing prices when computing the elementary aggregate index. This action has the same effect as imputing a missing price with prices that would have a price development since the price reference period equal to the average price development of the available product offers in the same elementary aggregate. See Chapter 8.

being replaced, or the most representative product offer. Moreover, the person making the replacement must have a detailed specification of the price-determining characteristics of the product to be replaced.

Where loose product specifications are used for local price collection, it is up to the price collector to find a replacement, following the operational rules supplied by head office. The latter then determines whether the selected replacement meets the specified criteria. It is up to head office, however, to replace missing products based on tight specifications. This can be more challenging in terms of later attaining an adequate sample of prices, as the limited leeway of tight specifications may mean that some shops in the sample may not sell the specified product, thus increasing the non-response rate. Alternatively, head office may change the tight description and perform quality adjustment centrally, possibly on the elementary aggregate index itself.

The imputation of missing prices and alternative strategies for choosing replacement product offers were discussed earlier in this chapter and are discussed in more detail, along with quality adjustment, in Chapter 6.

Separate rules apply to products subject to strong seasonal patterns, such as fresh food products or garments that are temporarily unavailable in certain months (see Section 7.1).

5.7 Closing outlets: outlet substitution and closing-down sales

Chapter 4 discusses the outlet dimension of sampling for surveys of prices for the HICP and describes the various approaches potentially available to the compiler. This section focuses on the operational aspects of price collection. Outlet bias is a sampling issue that is also addressed in Chapter 4. It arises from surveying retailers who are no longer representative, owing to reduced sales volumes. This may result from low competitiveness because of high prices, unpopular stock products or customer dissatisfaction stemming from low levels of customer service etc., is a sampling issue which is also addressed in Chapter 4.

Retail outlets close regularly, and the phenomenon should be dealt with by following the general principles for replacing product offers Essentially, outlet closures are handled through one-to-one resampling, This means replacing an outlet by another of the same type, in the same or a similar location, and selling the same or a similar range of products to similar customers. The replacement decision may be taken by a local price collector or by head office.

As with product offers, a more proactive approach to sample renewal is needed to cope with the natural turnover in outlets, which means keeping replacements and sample ageing to a minimum. This can be done by sample rotation, which involves full or partial resampling of the outlet sample at regular intervals. The resampling method can follow methods similar to those used for selecting the initial sample. Re-sampling involves an overlap period (December of each year) where the first period of the new sample overlaps with the last period of the preceding sample. This provides for chain-linking of the preceding sample and the newly selected one (see Chapter 4). The point to note here is the possibility of involving price collectors, who have first-hand knowledge of both new outlets in their localities and those that are on their way out. It can be very helpful to head office staff, who may have a more limited knowledge of the local market situation, for price collectors to be involved in the replenishment of the outlet sample,

When outlets are closing down, final sales prices may drive the index down. A problem may occur if the disappearing product offer is replaced by a product offer in another outlet which is not holding a sale. By linking the closing-down price to the price of the replacement outlet, with the use of direct overlap pricing, or when chain-linking, the index may drift away from the correct mid-term price development, resulting in a downward bias. In principle, price falls prior to closure should be reflected in the HICP, as long as the price reduction is not associated with shop-soiled or damaged goods. The subsequent price in a replacement outlet should ideally be introduced either by direct comparison or by some other method that does not lead to downward drift, if practicable. One such method, to be applied in the first month after the outlet closes down, could be to make an estimate of the price that reflects the *normal* price level in the closed outlet, based on the price history in the outlet and, where relevant, by reference to movements in the product's price in other comparable outlets. This estimated normal price can then be used when introducing the price of the replacement product. This is similar to the recommended treatment for out-of-season and in-season, seasonal products (see Section 7.1). Price collectors have a key role

in determining what is happening on the ground by, for example, recording whether an outlet is soon to close (indicated by, for example, a closing-down sale or a rundown in stock levels) and whether a price in an outlet soon to close is a genuine sale price or not.

5.8 Practical price collection procedures

5.8.1 Local price collection

No substantive advice is given here on the planning and organisation required for successful local price collection. The *Practical Guide to Producing Consumer Price Indices* (United Nations, 2009, ECE/CES/STAT/NONE/2009/2) provides guidance on good practice that countries might wish to adopt as part of their price collection procedures. Tight price collection and production schedules should include sufficient time for a collector to travel around all required localities and obtain all the prices required from each specified outlet at the specified time of day. The price collector should also have enough time to conduct all the necessary checks and re-pricing before submitting the prices to head office. There should be effective audit trails covering all aspects of price collection, including those involving head office.

5.8.2 Central price collection

Efficiency considerations can lead to prices being collected centrally by staff based at head office or regional offices, without monthly visits to retail outlets. Central collection can also be useful for products and services that are difficult to observe directly, such as utility tariffs; for those not sold from physical outlets; and for products subject to national pricing policies, either imposed by the government or established by a retail chain for all its outlets, for example. Prices can be collected from catalogues, from retailers' price lists for their outlets, by telephone, fax, letters, emails, postal and electronic questionnaires or by interrogating websites.

All these methods can be cost-effective and, just as importantly, can help to make sure the sample is balanced by, for instance, ensuring the inclusion of mail order and internet purchases in the HICP. Central price collection also has the potential advantage of increasing the sample of prices collected at minimal cost, as it eliminates the variable costs of employing local price collectors, which otherwise increase in proportion to the sample size. The most common data sources used in central price collection are dealt with below.

Prices may be obtained from mail order catalogues and their internet equivalents, to represent a certain type of retail outlet, or where high street catalogue stores have nationwide coverage with uniform pricing policies. Increasingly, mail order suppliers are offering their own internet services. In the case of both mail order and internet shopping, care must be taken to treat delivery prices and sales taxes consistently and correctly (see the earlier definition of a price and also Section 7.2).

Prices may be collected online either for convenience (where major stores offer the same prices online and in their outlets) or to maintain a representative sample in areas where online selling is increasingly used (e.g. books, DVDs and CDs). It is worth noting that while some retailers have an online presence with up-to-date prices reflecting those charged in their outlets, others publish online prices which may differ from their in-store prices. For instance, there may be lower basic prices online, but with a delivery charge or special offers for online customers only.

Some retailers have national pricing policies with no individual pricing discretion, even for sales and special offers. In such cases, a single store can be visited or the retailer's head office may agree to supply a single price list (covering all products or prices of specific selected products).

Prices may be obtained by telephone or fax, involving no ambiguity, since the product being priced is standard and the contractor will quote a standard charge (for example, electricians may be phoned to enquire about the charges for providing a new single electricity socket). Moreover, asking about prices by phone reflects common consumer behaviour. A further factor is that many service providers (e.g. plumbers or window cleaners) do not work from retail outlets. Even where they do, visits are difficult, given their variable and sometimes erratic working hours off-site at customers' premises.

Prices may be obtained by letter, fax or email, accompanied by relevant head office forms for completion and returned in cases where central collection is considered more efficient or where local price collection is not possible (for example, tariff prices). Examples include prices collected from a sample of local authorities, insurance companies, public utilities and telephone companies. However, these days email has generally overtaken letters and faxes.

Prices may be obtained from other government agencies or regulatory authorities, which can act as intermediaries, i.e. secondary sources, in the price collection process. In some countries this would be the case for electricity prices.

Some outlets or institutions have only one outlet. Examples include historic sites, museums, art galleries and theme parks. Often admission prices are published on their websites, so collecting prices online is the most practical solution. Alternatively, prices can be collected by phone, by fax or through a postal enquiry.

While customers still use traditional high street travel agencies to purchase both holidays and flights, in many countries such services are now purchased mainly online. Compilers should include both online price collection and prices collected from high street travel agents, in proportion to their market shares (see Section 12.5).

Prices can also be obtained from a variety of administrative sources. The use of administrative sources will be covered in some detail in chapters covering specific measurement issues such as the pricing of education, health and social services and areas such as public transport where there may be regulatory authorities. In these instances there can be a reliance on administrative data for both prices and expenditure. An example of the latter is where the expenditure associated with different tariffs is needed.

It is important to ensure that compilers of administrative data sources understand the importance of their data for the HICP and the extent to which the countries concerned rely on them. Service-level agreements on data coverage, definitions and deadlines for data delivery can be useful in making the relationship between data source and the country concerned more explicit.

When using other sources such as catalogues or the internet for prices, special care must be taken to ensure that the prices are correctly recorded and that they conform to HICP conventions regarding the inclusion of sales taxes, delivery charges and the inclusion of compulsory charges for using credit cards. See also Section 5.3.2 on the definition of a price and Section 7.2 on internet purchases. Procedures should also include a check that the prices are relevant to the index period, as the reference periods could be different, particularly for catalogue prices.

Importantly, all the usual price collection principles and quality assurance concerns remain relevant for prices collected online, including the need for detailed descriptions, immediate availability of the product for purchase, etc. One possible source of difficulties is retailers' propensity to regularly change the format and content of their web pages. Print screens are a possible way to retain proof of the price, unless web-scraping is used.

Finally, to reiterate an earlier point, exploiting different data sources through central price collection can help keep the HICP representative of the various outlets customers use, but only if product offers are sampled in proportion to sales per outlet-type.

5.9   Detecting pricing errors

5.9.1   Checking and editing data in the field

Several tests can be carried out on price data collected in the field, especially if those data are entered into hand-held computers or tablets. The tests can be carried out at the time of price collection and errors can then be corrected without any need for a follow-up visit to the retail outlet.

Some basic tests include whether a price has been collected and whether it has shown any change. The most useful tests to detect outliers are the *price change* test and the *minimum-maximum* (or min-max) test. In both cases, the thresholds used to identify outliers that may be worth investigating can be determined by the number of outliers detected and the proportion subsequently proven to be price collection errors. Thresholds will vary according to product type.

Price change test

The price collected is compared with the price for the same product in the same shop in the previous month. It is subject to further checking if the change exceeds plus or minus a percentage threshold specific to the product and determined by the month-on-month variance in previously recorded prices, excluding sale prices.

Minimum-maximum test

This identifies cases where the price entered is above a maximum or below a minimum pre-set indicative threshold price for the product of which the particular product offer being priced is representative. The range is derived by applying a scaling factor to the validated maximum and minimum prices for product offers observed for that product specification in *the previous mo*nth. The scaling factor is chosen so that an appropriate number of price observations are marked for checking, based on past experience of the number of incorrect prices encountered.

In both the above tests, it is important to identify sales prices and any changes in the price-determining characteristics of the product whose recorded price is being checked, to identify whether it is an outlier.

Other tests can include the number of months for which a price has remained unchanged, and whether a price has been collected and, if not, why not. The price collector may conceivably have forgotten to collect a price.

Where hand-held computers or tablets are used, these tests can be programmed so that if a test fails, a warning message appears.

The same tests can be carried out on the central computer system at head office, though not in real time.

It is important to note that prices should not be automatically excluded if they fail the above checks. The onus is on the price collector to identify and distinguish between outliers and errors and to justify the decision to exclude a price.

Further details are given in The Practical Guide to Producing Consumer Price Indices.

5.9.2 Data checking and editing at head office

Price collectors and head office have different but complementary roles in the quality assurance of price quotes. The price collector focuses more on whether a price looks reasonable compared with previous prices collected in the same shop for the same product offer. Head office, on the other hand, has access to all price quotes submitted by collectors at a given point in the monthly production cycle. This means that checks can be carried out on, for example, whether the price quote for a particular product in a particular outlet looks reasonable when compared with all price quotes submitted for all retail outlets for that particular product, or with all price quotes submitted for that product by outlets of a similar type or located in the same region.

Checking can be carried out by manual inspection (non-statistical checking) or by applying statistical algorithms (statistical). Non-statistical checking includes the price change and minimum-maximum tests referred to above,, which rely on some form of automated analysis to identify price quotes warranting more detailed inspection and tests of logic, for instance if a sale price is higher than the non-sale price and vice versa. An example of statistical checking is the use of the Tukey Algorithm. Further details are given in The Practical Guide to Producing Consumer Price Indices.

Verifying that the calculated index movements are plausible is another important part of data checking and validation.

5.9.3 Rejection of price observations

The HICP regulations do not address editing, data processing or validation procedures. Individual EU countries are responsible for determining the practices that best suit their indices.

However, a common framework for the rejection of price observations should secure the comparability, reliability and relevance of the HICPs.

The following guiding principles are useful:

- Reported prices should normally be accepted.

- Prices should be rejected or adjusted only by reference to specific information relating to the individual price observation concerned.

- When, as a result of validation procedures, reported prices have to be rejected and new observations cannot be established, rejected prices should be treated as missing observations.

- Other methods may be used. In this case, Eurostat may request that the methods used must to be shown not to result in an HICP that differs systematically from an HICP constructed in line with HICP Regulations by more than 0.1 percentage points on average, taking one year against the previous year.

Annex 5: An overview of price collection

The following diagram (Figure 6.1 from the CPI manual, p. 86) summarises good practice with regard to price collection. The procedure described is a way to meet HICP legal requirements, but it is not prescribed in detail by any regulations or other agreements.

Chart 5.1: Summary of price collection practice

PRICE COLLECTION

Figure   Price collection procedures
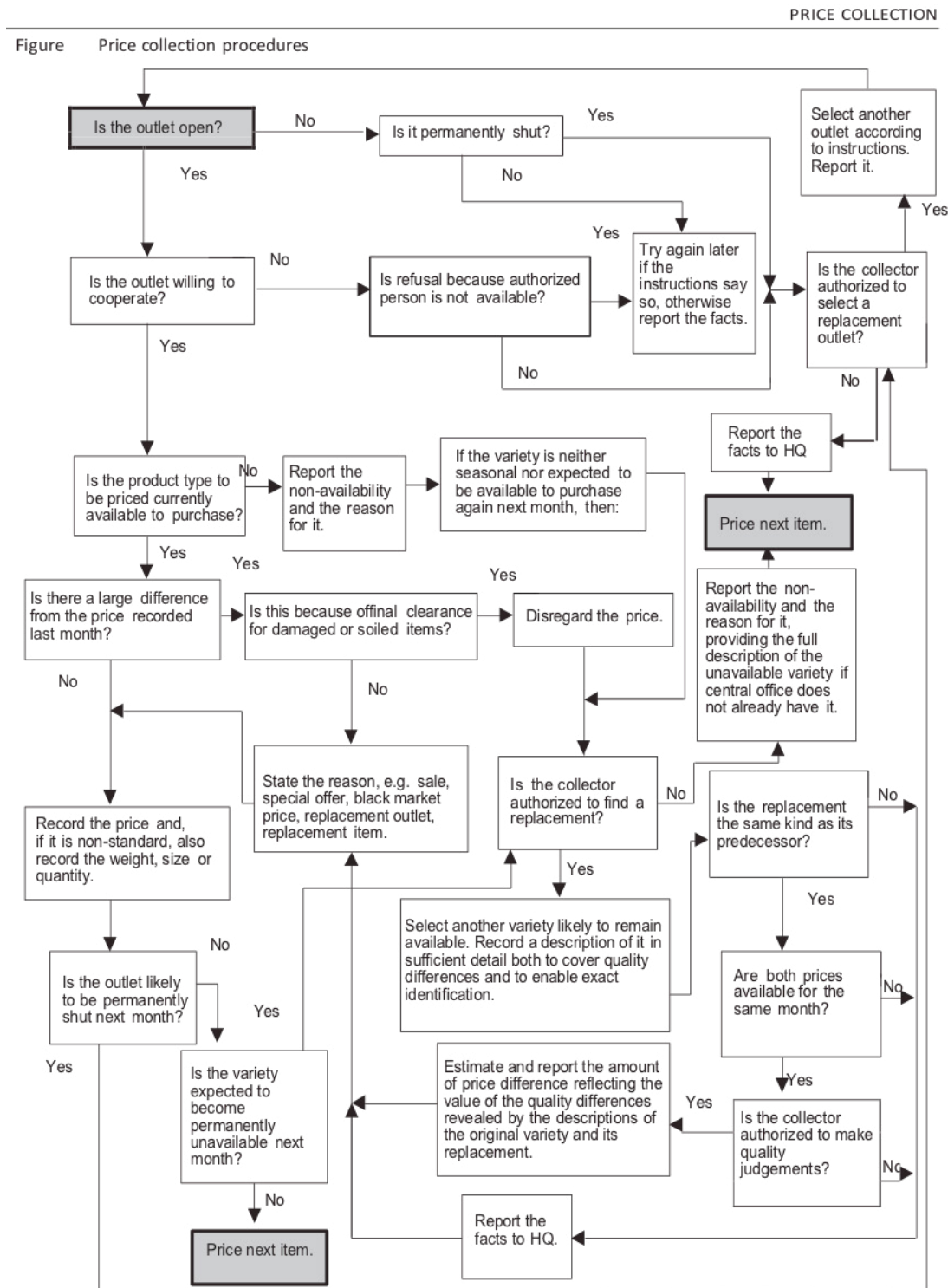
6 Replacements and quality adjustments

6.1 Introduction

The HICP, as a fixed-basket index, should ideally follow the price development of a fixed representative sample of product offers. Given the dynamics of the markets for consumer goods and services, this can be challenging (see Section 4.3.2).

Keeping the sample updated is done in two ways. The first way consists of periodic comprehensive revisions of the entire sample by resampling using the procedures described in Chapters 4 and 5. The second way consists of replacing single product offers in the given sample between the periodic revisions, because they are either no longer available in the outlets or no longer representative. This chapter describes the procedures that should be used to replace individual product offers.

To reflect the price changes consumers face, the index computation should compare the replacement price with the corresponding price in the price reference period or previous price. The assumption is that the replacement product offer is comparable to the reference or previous product offer. However, replacement product offers are not always fully comparable, as their characteristics or *quality* may differ from the reference or previous product offer.

As the HICP is a measure of *pure price change,* it should be unaffected by quality differences in replacement situations. As such, these quality differences need to be addressed.

Quality in general can be understood as the characteristics of product offers. In particular, it relates to those characteristics that influence consumers' willingness to pay for the product. This means that quality covers both the technical characteristics of the product, and how consumers perceive the product.

Quality adjustments are applied to modify prices between replaced product offers and replacement product offers, so that they become comparable. Such modifications are often needed in replacement situations where the characteristics of replacement product offers differ from the characteristics of the replaced ones. Practically, quality adjustment can be carried out as a modification of either the current price or the price in the price reference period. Quality adjustment can be performed using various methods. There are two main approaches or types of methods:

- *Explicit* methods estimate the value of quality change by evaluating changes in product characteristics.

- *Implicit* methods estimate the value of quality change from other observed price differences between similar product offers that are available at the same time.

Various methods for both explicit and implicit quality adjustment are described in this chapter.

Quality change in the HICP is to be understood from the consumer's perspective. That is, quality change is essentially a change in product characteristics where consumers perceive a difference that matters to them, when they decide to purchase a product.

Some important choices between methods need to be made in terms of the strategy employed to select replacement product offers and choose the quality adjustment method that will be used. The views on these choices have traditionally varied between Member States, which presents a major challenge for harmonisation.

Replacement and quality adjustment can have an important impact on the HICP. While only a minority of product offers are replaced in a single month, over a full year a large part of reference product offers in some product categories (e.g. electronic goods, clothing) are often replaced. This requires a significant effort in developing and maintaining a strategy for quality adjustments and replacements. Replacements and quality adjustments are intrinsically linked and should be designed together.

This chapter starts with the legal requirements and some general principles, followed by a description of the various methods that can be used for quality adjustment.

The chapter draws on earlier work done in the European Statistical System (ESS), in particular, the project under CENEX ([40]) on quality adjustment of HICPs.

([40]) Centres and Networks of Excellence.

6.2 Legal requirements, definitions, concepts and supporting material

Basic information

In Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, Article 2(17) gives the following definition:

'a) *'basic information' with reference to HICP and HICP-CT means data covering:*

    i. *purchase prices of products which need to be taken into account in order to compute sub-indices in accordance with this Regulation,*

    ii. *characteristics that determine the product price,*

    iii. *information on taxes and excise duties levied,*

    iv. *information as to whether a price is fully or partially administered, and*

    v. *weights reflecting the level and structure of the consumption of the products concerned.'*

It should be noted that the second point listed in this article is essential in terms of quality adjustment and replacements, the topic of this chapter.

The concept of basic information thus defined is referred to in Article 5(1) of this Regulation (Article 5 being devoted to data requirements):

'Basic information collected by Member States for the harmonised indices and their sub-indices shall be representative at Member State level.'

Comparability

Article 4(2) of Regulation (EU) 2016/792 defines the comparability criteria of HICPs, as follows:

'Any sub-indices of the harmonised indices that deviate from the concepts or methods of this Regulation shall be deemed comparable if they result in an index that is estimated to differ systematically by:

    a) *less than or equal to 0.1 percentage points on average over one year against the previous year from an index compiled following the methodological approach of this Regulation, in the case of the HICP and the HICP-CT; …'*

This criterion can be useful when quality adjustment methods have to be adapted to reflect national circumstances.

Missing prices

In Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) no 2494/95 concerning harmonised indices of consumer prices, Article 6 gives the rules for the identification and treatment of temporarily versus permanently missing prices. These rules are as follows:

'1. Member States shall produce HICPs using the observed prices of the target sample.

Where the target sample requires monthly observation, but observation fails due to non-availability of an item or for any other reason, estimated prices may be used for the first or second month but replacement prices shall be used from the third month.

Where, exceptionally, the target sample requires observations less frequently than monthly, estimated prices shall be used for those months where observed prices are not required. Estimated prices may also be used on the first occasion on which price observation fails. Where observation fails for a second consecutive occasion, replacement prices shall be used.

2. Where, in the circumstances referred to in this Article, replacement prices are not available, estimated prices may continue to be used, provided that the extent of their use is limited to a level appropriate for achieving comparability.'

Concepts and terminology of replacements and quality adjustments

Article 2 of Regulation No 1749/96 gives the following definitions.

'9. 'Observed price' means a price actually confirmed by the Member States.

10. 'Replacement product offer' means a product offer with an observed price that replaces a product offer in the target sample.

11. 'Replacement price' means the observed price for a replacement product offer.

12. 'Estimated price' means a price which is substituted for an observed price and is based on an appropriate estimation procedure. Previously observed prices shall not be regarded as estimated prices unless they can be shown to be appropriate estimates.

13. An 'elementary product group' means a set of product offers that are sampled in order to represent one or more consumption segments in the HICP.

14. An 'elementary aggregate' means an elementary product group stratified, for instance by regions, cities or outlet types and so refers to the level at which observed prices enter the HICP. Where elementary product groups are not stratified, the terms 'elementary product group' and 'elementary aggregate' shall have the same meaning.

15. An 'elementary aggregate index' means a price index for an elementary aggregate.

16. 'Quality change' means that a replacement has resulted in a significant difference in the degree to which the replacement product offer serves the consumer purpose of the consumption segment to which it belongs, whenever the Member State judges so.

17. 'Quality adjustment' means the procedure of making an allowance for an observed quality change by increasing or decreasing the observed current or reference price by a factor or an amount equivalent to the value of that quality change.'

For definitions of concepts related to sampling, see Chapter 4.

Definitions of quality adjustment methods are given in Sections 6.7-6.8 of this chapter.

Article 2(a) of Regulation No 1749/96 states the requirements for replacements and quality adjustments:

'7. The HICP shall provide a measure of pure change in prices, unaffected by quality change. It shall:

a)   reflect the price change on the basis of the changed expenditure of maintaining the consumption pattern of households and the composition of the consumer population in the base or reference period;

and

b)   be constructed by making appropriate adjustments for observed quality change. Quality adjustments shall serve the reliability, and in particular the representativity of the HICP as a measure of pure price change.

8. Concerning quality change, the judgement shall be based on due evidence of a difference between the specification of a replacement product-offer and the product-offer it replaced in the sample; That is, a difference in the product-offers' significant price-determining characteristics, such as brand, material or make, that are relevant to the consumer purpose in question.

A quality change does not arise when there is a comprehensive annual or less frequent revision of the HICP sample. Its inclusion shall be made by establishing the appropriate chain links. Revisions of the HICP sample do not remove the need to introduce replacement product offers without delay in between two revisions.

9. The representation of an elementary product group or an elementary aggregate shall be defined by the expenditure weight associated to it. Other weightings may be used within elementary aggregates on the condition that the representativity of the index is ensured.

10. 'Reliability' shall be assessed according to 'precision', which refers to the scale of sampling errors, and 'representativity' which refers to the lack of bias.'

Furthermore, in Article 5 of the same Regulation, the following is stated:

'1. Quality adjustment methods shall be rated as follows:

a)   A methods: those which are considered to deliver the most reliable results, in terms of precision and bias;

b)   B methods: those which may deliver less precise or less representative results than A methods, but are nevertheless considered also acceptable. B methods shall be used in case A methods are not applied; and

c)   C methods: all other methods, which shall hence not be used.

2. Standards concerning the rating of quality adjustment methods shall be developed and issued by the Commission (Eurostat) after consultation at the SPC, following a case-by-case approach and with due regard to aspects of cost-effectiveness and the context in which they are applied.

The rating of quality adjustment methods does not preclude the adoption of implementing measures on this subject in accordance with Article 5(3) of Regulation (EC) No 2494/95.

3. A and B methods shall be deemed to be appropriate quality adjustment methods. HICPs for which appropriate quality adjustments are made shall be deemed to be comparable. Other things being equal, A methods shall be given the preference over B methods.

4. In the absence of appropriate national estimates, Member States shall use estimates based on information provided by the Commission (Eurostat) where these are available and relevant.

5. In no case shall a quality change be estimated as the whole of the difference in price between the two product- offers, unless this can be justified as an appropriate estimate.

6. Where no appropriate estimates are available, price changes shall be estimated as the difference between the replacement price and that of the product-offer it has replaced.

7. Replacement product-offers:

a)   shall be either 'essentially equivalent', if no quality change is observed between the replacement product-offer and the one it replaced in the sample, or 'equivalent by quality adjustment', if a quality adjustment is necessary for an observed quality change between the replacement product-offer and the one it replaced in the sample;

b)   shall be selected from the same consumption segments as the replaced ones, so as to maintain the representation of consumption segments;

c)   shall not be selected according to similarity of price. This shall in particular apply where replacements have to be made after goods or services have been offered at reduced prices.'

6.3 Principles

The following seven principles express the general ideas that should guide index compliers in developing quality adjustments and replacement strategies:

1.   Replacements should maintain representativity.

2.   Replacements should be made timely.

3.   Replacements of product offers should be selected so that they represent changes in product characteristics that occur in the market.

4.   The consumer perspective is primary.

5.   Fashion variation, in the sense of variations in prevailing style, is not a quality change.

6. Quality change from all relevant causes should be recognised.

7. Conventions and specified recommendations apply for quality adjustment in specific product areas.

6.3.1 Principle 1: Replacements should maintain representativity

In Article 6(1) of Regulation No 1749/96, it is stated that an imputed (estimated) price may be used for the first two months when a product offer is not available, on the condition that this is an appropriate estimate. From the third month of unavailability, a replacement price must be used. This rule serves to ensure that the price data used stays representative for current purchaser transactions and that the index does not become unduly influenced by observations that are out of date.

However, considering that a product offer may be only temporarily unavailable and may possibly come back soon, the rule allows an imputed price to be used for up to two months.

To impute for a missing price, a useful practice is to assume that the price development for the product offer in question was the same as for the observed prices on average in the same elementary aggregate. Here the price development referred to can be either (i) the price development since the preceding month, or (ii) the price development since the most recent December (the price reference period). The choice between options (i) and (ii) can be seen as partly a matter of computational convenience, as it is probably not very critical to the accuracy of the HICPs. However, option (i) could in principle be seen as slightly more accurate, by being based on most recent data. In the practical computation of the elementary aggregate index, the imputation is conveniently accomplished by just dropping the product offers with missing prices.

6.3.2 Principle 2: Replacements should be made timely

Article 2a(4) of Regulation No 1749/96 implies that keeping the sample representative is not limited to the (annual) revisions of the HICP sample. Timely replacements should be made so as to ensure that the sample is representative at all points in time, irrespective of the frequency of the comprehensive sample revision. They further serve to allow for quality adjustments where potential quality changes take place.

A replacement does not have to wait until the product offer is no longer available. A replacement can and should be made when it can be noted that the product offer is no longer sold very much, i.e. becomes less representative of what is currently being purchased, because, for example, it has become less visibly displayed in the outlet. This will help to keep the collected price data representative of current purchaser transactions.

Annual sample revisions and in-year replacements thus complement each other in keeping the sample up-to-date. Annual sample revisions do so primarily in the longer term and replacements in the shorter term. It is important that replacements are carried out every month if they are required, even if it is near the end of the year when the sample will soon be revised. This is needed to allow any necessary quality adjustments to enter the index properly and make the index show the actual price development correctly.

Price collectors should be instructed to look out for indications that product offers priced in the outlets are becoming less representative of current purchases. When this occurs, timely replacements should be made. The same principle applies for centrally collected prices (see Chapter 5 for further details).

6.3.3 Principle 3: Replacements of product offers should be selected so that they represent changes in product characteristics that occur in the market

According to Article 5(7b) of Regulation No 1749/96, replacement product offers must be selected from the same consumption segments as the replaced ones. They should also be selected according to similarity in use of the product, not according to similarity in price.

Product specifications are the specifications that define the products to be priced within target samples and are in effect instructions given to the price collectors so that they can select product offers to price within the sampled

outlets. These product specifications delineate the product categories within which replacement product offers should be selected. They are not to be confused with the actual product descriptions recorded by price collectors for the particular product offers or models priced in specified outlets (see Section 5.4).

Product specifications may to varying degrees be loose or tight (see Chapter 4).

A *tight* product specification describes the set of product characteristics exactly or nearly exactly, possibly defining an essentially unique product model. Example: a specific TV model of a specific brand, with a specific screen size, and with specific other features.

A *loose* product specification describes a range of product characteristics, which may potentially be common to several similar product models. Example: a class of TV models specified by having a screen size within a prescribed range.

Another example: for sofas, a loose specification could allow for all sofas with three seats, while a tight specification prescribes a particular model name, design, colour, etc. In principle, a very tight specification corresponds to a unique value of the International Article Number (EAN).

Loose product specifications allow for quality change to occur in replacement situations whereas tight product specifications generally do not. However, with tight specifications it may be difficult to find directly comparable replacement product offers with no differences in quality.

Confining replacements to a too tight product specification is not suitable in product categories where product development (improvements or modifications) may be important, or where models change frequently, such as for clothing or technology products. Such constraints would lead to an increasingly obsolete sample of models, which is no longer representative of current purchases.

For example, consider a tightly specified technical product defined in terms of performance, such as a camera with a specified number or range of pixels. Due to ongoing technological product development, it may soon turn out that practically all available models now have a performance above the specified range; and the few models within the range still available are perhaps not representative. Accordingly, where tight product specifications are used, it is particularly important that these are reviewed frequently, at least annually. However, this may have to be done within a year, particularly for technological products. If this is the case, quality adjustments should be made for any quality changes implied by changed product specifications.

The conclusion is that in product areas where important product developments are expected, some care has to be taken in defining the product specifications where replacements are to be selected. There the product specifications have to be loose enough to encompass representative quality changes so that these can be captured in the sample and adjusted for.

Tight product specifications on the other hand may be suitable in relatively stable product areas without important or rapid product developments, e.g. food and beverages, and personal services. In such product areas, tight specifications may help in sampling precision by reducing the random variability in replacement selection and quality adjustment.

In practical terms, the design of a replacement strategy can stipulate replacements to be carried out either by price collectors within given loose product specifications, or by modifying tight product specifications and applying appropriate quality adjustments. In the latter case, some form of control is needed to keep the target sample conceptually stable and prevent a drift in product specifications.

Replacement strategies: most similar or most representative

Some principle or strategy has to be chosen for the instructions to price collectors on how to select replacement product offers within product specifications. There are basically two options here: either to select the product offer that appears *most similar* to the replaced one, or to select the apparently *most representative* (i.e. most sold) product offer that fulfils the product specification.

The approach of replacing with the *most similar* product offer has an advantage in terms of sampling precision and smaller quality adjustment variability. But it has an important drawback in potentially not following the overall quality developments within the specified product type, if this development is significant, as is the case with technology products. Annual resampling is an important process to reduce this problem. However, it cannot

eliminate it, because there is a risk that price changes are not captured properly if product models change in between annual resamplings, which is often the case (see below).

The second option of replacing with the *most representative* product offer (within the product specification) has the important advantage that it follows the developments in the market and maintains the representativity of the sample. A less attractive feature is the uncertainty involved in selecting replacements and in applying quality adjustments.

Whichever strategy is followed, there will always be a degree of uncertainty and spurious variability, both in replacement situations and in the application of quality adjustments.

To some extent judgement is required, because there is a trade-off between providing for sampling accuracy by similarity and providing for representativity of currently sold products. Article 5(7a) of Regulation No 1749/96 stipulates that a replacement product offer should be similar enough to be either essentially equivalent or equivalent by quality adjustment. However, replacement product offers are not required to be perfectly similar, if that would not be representative for current purchases, because such a practice could tend to hide true price changes.

For example, a furniture company can have the policy not to change prices of existing furniture models but instead to introduce new models with other prices. In such cases, the most representative strategy is the preferred solution. Namely, the price changes seen by consumers will not be appropriately reflected in the index, unless newly available models that are newly preferred by consumers are taken as replacements. In such situations, appropriate quality adjustments have to be applied

The option of replacing between outlets

Practices vary between countries as to whether replacement product offers are selected only in the same outlet as the replaced one or also between outlets. The choice between these two options is allowed so as to reflect country-specific conditions and ensure comparability of results.

Occasionally, there can be reasons to choose a replacement product offer from a different outlet when the sampled outlet closes down or no longer stocks product offers from the consumption segment in question. For example, if a DIY store formerly also sold garden equipment but does not do so anymore, a solution may be to price the products in another outlet. However, this solution is possible only if the reference prices are comparable or can be reliably observed retrospectively in the replacement outlet.

A replacement between outlets can potentially lead to a quality change, e.g. if the replacement outlet is not fully comparable to the replaced one in either the user functionality of products or service level. Such quality changes should, in principle, be adjusted for, if they are deemed important to consumers and can be estimated.

6.3.4 Principle 4: The consumer perspective is primary

In accordance with Article 2(16) of Regulation No 1749/96, a quality change is defined as [related to] a replacement resulting in a significant difference in the degree to which the replacement product offer serves the consumer's purpose of the consumption segment to which it belongs.

In other words, a quality change means a change in *functionality* in consumers' use of the product. Or in more tangible terms, there is a quality change when the replacement product offer differs from the replaced one in some product characteristics that matter to consumers.

The HICP takes an acquisition approach rather than a use approach. This means that the relevant product characteristics are essentially those that consumers are aware of when they decide to purchase the product. In accordance with economic reasoning, it is assumed that consumers and others think and behave rationally and are well informed, although this is possibly only partly true in reality. It is thus assumed that consumers make themselves aware of all those quality aspects that have important consequences for them, such as safety, health hazards and ethical aspects, etc.

However, this means that the expected use of the product is also a relevant issue in the acquisitions approach, as consumers more or less have the use in mind at the moment of purchase. Below are some examples on this point.

Fuel economy of car models: if a replacement car model differs from the replaced model in fuel consumption in litres per 100 kilometres, then there is a quality change. This is because the replacement product offer differs from the replaced one in a characteristic that matters to consumers. This quality change may be adjusted for by assessing and calculating the value of the difference in fuel consumption over a typical number of years of use (see Section 12.3).

A potential objection against this example and quality adjusting for fuel economy in cars could be that this would not be seen as concerning the car itself but only the use of it over years to come, and the future consumption of fuel. This objection would be valid if consumers do not think about fuel economy when they purchase cars. But as there is evidence from media reporting, etc. that on the whole consumers do care about fuel economy at the moment of car purchase, it seems important to quality adjust for it.

Energy efficiency label for electric appliances, and *life expectancy for light bulbs:* for household appliances like refrigerators or for light bulbs, the energy label is a relative indicator of economy with respect to energy (electricity) use. A change in energy label is a quality change, analogously to change in fuel consumption in the preceding example. Namely, the energy label is there to be seen by consumers, and it cannot be entirely unimportant to them when they purchase the product.

Product modifications arising from new legal requirements for products: occasionally, categories of products become subject to new legal requirements for safety, health or environmental protection and are accordingly modified in characteristics. Such modifications are quality changes to the extent that they entail changes in user functionality, as seen by consumers at purchase. If the modifications are of a kind that many consumers do not care much about, then this makes them less important as quality changes. *Tentatively*, it could be useful to take as a convention that in cases of doubt, such product modifications due to legal requirements should not be quality adjusted for.

Renovations for rental dwellings: major renovations of rental dwellings (e.g. new heating system or new bathrooms) entail quality changes to the extent that they *improve* (or worsen) the functionality of the dwellings to the tenants. Some kinds of measures, such as replacing all pipes for water and sewerage, are needed after many years of use to *maintain* functionality but do not change it. The latter measures are in themselves not quality changes, and rents should not be quality adjusted for them. But if other measures implying quality change, such as new heated floor, are made at the same time, these should be quality adjusted for (see Section 12.4).

6.3.5   Principle 5: Fashion variation, in the sense of variations in prevailing style, is not a quality change

Fashion variation, in the wider sense of variation in prevailing style, or temporarily varying consumer preferences, is important not only in areas like clothing (see Section 12.7) but also for many other product areas which are affected by temporary trends in consumer preferences, including technically complex products such as electronic goods, cars and appliances. The point is to decide what product characteristics need to be quality adjusted for and which do not.

Fashion preferences typically move back and forth, in opposite directions from time to time, such as skirts being sometimes short and sometimes long. If changes in both directions were treated as quality improvements, the result would be absurd, with a cumulating downward bias in the index. Changes in relatively superficial product characteristics such as colour or cover design are perhaps appreciated at first but soon become dated. So such features are usually fashion rather than quality and should not be adjusted for.

It is crucial for the quality of the index that fashion variation can be identified as such and not be quality adjusted for. This is sometimes challenging.

An example for rental dwellings is when a dwelling is remodelled to *open plan*, where the kitchen is integrated with the living room. The idea is not new but has become more popular than before in some countries. It may not yet (2017) be quite clear whether this feature reflects fashion or lasting quality change; so there is an uncertainty in what should be considered fashion (i.e. not lasting). A further perhaps disturbing consequence is that the number of rooms, as a quality-related characteristic of the dwelling, may not become perfectly comparable through time.

Fashion, in the sense of specific temporary consumer preferences, is to be distinguished from *fashionability*, in the sense of having characteristics that are in accordance with current consumer preferences.

In principle, fashionability, unlike fashion, could be regarded as an aspect of quality. But there is no question of quality adjusting for the fashionability decline of ageing models. Namely, first, the decline is not connected with a replacement situation. Second, over time the decline cancels out with the fashionability increase in the introduction of a new model, and that increase should, as a fashion-related issue, not be quality adjusted for. Or in other words, to avoid a growing bias in the index, there has to be a symmetry in *not* quality adjusting for either the declines or the increases in fashionability during the life cycle of a model.

6.3.6 Principle 6: Quality change from all relevant causes should be recognised

Product development due to technology enhancement is obviously an important cause of quality changes, but it is not the only one.

Generally, symmetry has to be applied between treatments of improved versus worsened quality. For example, it may occur that a replaced TV model happened to have some unusual luxurious feature that the replacement model does not have. Then the quality change is to be treated in analogy with changes in the opposite direction, i.e. improvements. This symmetry is crucial to prevent a cumulating bias in the index.

Another kind of quality change is where there is a change in contract conditions (other than by legal requirements, see Section 6.3.4) for the use of a product.

An example is where a warranty for a car model is introduced, discontinued or its length changed. Such a warranty can be important to car buyers and influence their decisions. Thus its introduction or disappearance is to be treated as a quality change and should be adjusted for.

Likewise, a replacement insurance policy may become subject to a change in conditions that makes it less valuable or more valuable to the policyholder. For instance, there may be a change in the excess amount that is to be deducted from the compensation paid out in the case of a claim after damage. Then a quality adjustment is to be made for a calculated change in the value of the policy to the policyholder (see Section 12.2).

It should be noted that quality adjustments should be applied to all observed quality changes in the sample.

6.3.7 Principle 7: Conventions and specified recommendations apply for quality adjustment in specific product areas

Between consumption segments there are differences in the need for, feasibility of and relevance of, approaches for quality adjustment. Therefore, specific guidance has been developed for specific product areas (clothing and footwear, etc.), which is elaborated in other chapters of this manual.

To pragmatically meet the problems of quality adjustment, conventions — practices accepted by decision — have been adopted in various product areas.

Article 5(6) of Regulation No 1749/96 states the following:

> *'Where no appropriate estimates are available, price changes shall be estimated as the difference between the replacement price and that of the product offer it has replaced.'*

This convention is suitable in product areas where quality changes are deemed either to be small on average, or quality adjustment would be too difficult to be feasible.

Disregarding quality changes by convention in a product group is naturally not desirable if quality changes are deemed to be important for that product category. However, this kind of convention is transparent in a way, as it is straightforward to communicate to index users what has been done, or rather what has not been done.

Conventions for specific product areas have been agreed concerning what kind of product characteristics or variables should be chosen to measure quality change and govern the quality adjustment method employed.

A convention that is generally used for technical products like computers is to take variables measuring performance or capacity as measures of quality. Observed changes in such variables are thus used as measures of quality changes and as the basis for quality adjustment.

For example: the quality adjustment of computers is based largely on changes in performance measuring variables such as clock rate (speed) in gigahertz, primary memory (RAM) in gigabytes, and the size of the hard drive in gigabytes. Using such variables is not without reason, as their values are prominently displayed in advertisements for computers, computer buyers care about them, and they do say something about the computer's functionality. But the kind of functionality that really matters to consumers is probably more how well the computer works with relevant software, and using the variables mentioned for this is not perfect but is something of a convention.

For example, many home computers are used for games. This kind of software from time to time is updated, with new or improved user functionality. Typically, this comes at the price of requiring more and more computer capacity (speed and memory) to work. Thus the technical capacity and performance of the computer (albeit indirectly) are relevant to the consumer when it comes to the computer's functionality.

6.4 Techniques in quality adjustment

6.4.1   General remarks

Simplistic extremes

There are two rather simplistic and extreme positions on how to treat a quality change:

1.   To disregard the quality change and compute the index as if the quality change had not happened.

2.   To consider the quality change in monetary terms as equal to the simultaneous price change, and compute the index as if neither the quality change nor the observed nominal price change had happened.

As noted in Section 6.3.7, position 1 is generally undesirable, particularly when quality changes may be important, but potentially it is sometimes acceptable as a convention. However, position 2 is generally worse, as it is liable to make the index hide true price changes. It relies on a false circular reasoning by using an unverified assumption about the price change that is to be measured. It cannot be assumed without supporting evidence that a price change corresponds to a quality change. Position 2 is in principle ruled out by Article 5(5) of Regulation No 1749/96.

Pitfalls

Generally, the application of quality adjustment has to be properly tuned, because too little quality adjustment and the misapplication of quality adjustment could potentially yield misleading index series:

- Neglected quality adjustment could yield overstated inflation over periods with strong quality improvements;

- Quality adjustment that is misapplied by taking fashion variation as quality change could likely bias the index downwards;

- Quality adjustment that is not applied in ways that are mutually consistent could yield incomparable results.

Naturally all such pitfalls should be avoided.

Elements of judgement

Procedures of quality adjustment use both observed product characteristics, such as the screen size of a TV set, and some elements of judgement. Judgement means making decisions by considerations that possibly go somewhat beyond mechanical rules. For example, judgement is involved when choosing methods and replacement product offers, and sometimes more or less when assessing the monetary value of the quality change for individual

replacements. Also, and not least, in quality adjustment by hedonic regression, judgements have to be made when deciding quality variables, updating frequency and the hedonic model used.

Judgements should not be arbitrary. They must be supported by evidence of product knowledge and applied with due competence, following clear instructions and documentation routines.

6.4.2   Criteria for quality adjustment methods

Five general criteria are useful to assess the applicability of quality adjustment methods.

1.   *Acceptance.* Methods should be widely accepted among price statisticians; this includes that they should avoid obvious bias.

2.   *Justifiability.* Methods should be justifiable to users with respect to the explicit and implicit assumptions on which they are based on.

3.   *Maintaining representativity.* Rules for replacements, etc. should ensure that high-volume selling products are always represented in the sample, unless measurement problems are deemed insurmountable (rarely the case).

4.   *Applicability.* Methods should be readily applicable in many standard replacement situations.

5.   *Sustainability.* Methods should be expected to be applicable for several years (for example, the methods applied should not depend on the presence of experts who may not be continually available as needed.).

It is helpful to classify or rate the applicability of quality adjustment methods in different product areas, according to how well they meet the above criteria. For each product area, possible methods should be rated as A, B or C methods, according to the scheme in Article 5(1) of Regulation No 1749/96, quoted in Section 6.2 above.

Whatever method is used due competence and training are essential for staff working on quality adjustment.

6.4.3   Quality control

Quality adjustment is a difficult task, which depends to a greater or lesser extent on judgements and generally small numbers of observations for use in auxiliary calculations. Potentially, this means a considerable degree of uncertainty, which can affect the index.

Forms of quality control should be implemented to collect and monitor indicative evidence as to how well the quality adjustment seems to work. This is the responsibility of Member States and should be done at their own initiative. Basic indicators include at least a count of the quality changes and a record of the types of quality adjustments made. The latter record can be achieved through some type of database or summary information in some form.

A useful summary statistic for monitoring quality adjustments is the implicit quality index (IQI). It is calculated by dividing a hypothetical HICP called standard reference index (SRI), where no quality adjustments are made, by the actual HICP.

The standard reference index is usually based on simple averages of prices in elementary aggregates and then weighted according to the same weighting scheme as in the actual HICP. If package-size adjustments are applied (see Section 6.7.2), these should be applied for the standard reference index too. Namely, the idea is to leave out quality adjustments in a proper sense, which package-size adjustments are not, as they are in reality a rescaling of quantities.

The calculation is:

IQI = SRI / HICP

It should be noted that implicit quality indices can be useful at any level of aggregation, from elementary aggregate indices upwards.

Implicit quality indices can be interpreted as the estimated average development of quality change. This allows for an assessment of the performance of the quality adjustments made. When quality adjustment works appropriately, the HICP without quality adjustment (standard reference index) will increase faster than the actual HICP if quality increases on average, and vice versa.

For example, prices for computers may have remained roughly constant during a year while quality adjustments made to the HICP sub-index for computers results in a 30 % decrease (from December of the preceding year to December of the current year). This means that the index has been quality adjusted for a quality improvement during the year, in per cent to the amount of

$$100 \times 100 / (100 - 30) - 100 = 42.9 \text{ \%}$$

This outcome would be shown in the implicit quality index.

The calculation of implicit quality indices for individual product groups or for more aggregated levels can highlight any potential biases to the index as a result of the quality adjustment methods used. For example, some apparently substantial quality improvements may show up unexpectedly in some product area like towels, where no strong product development is known to have occurred. Such a result may call for a review of the quality adjustment practices. Standard reference indices for higher aggregate levels can indicate such problems occurring generally, and those for low-level aggregates can localise problems occurring in specific product areas.

6.4.4   Explicit and implicit quality adjustment methods

The ideas

Quality adjustment may be carried out as a modification of either the current price or the price reference period price. Quality adjustment may be performed by various methods.

As described in Section 6.1 above, there are two main approaches or types of methods for quality adjustment. These are: (i) *explicit methods*, which estimate the quality difference based on product characteristics, and (ii) *implicit methods*, which estimate the value of quality change based on differences between observed prices of other product offers.

For both methods, the aim is to adjust prices for quality change in replacement product offers, so that the index reflects *pure* price change, unaffected by quality change. But the two types differ in the way they accomplish this.

Generally, *explicit* methods work in two steps: first, they estimate the value of the quality change, and second, they modify the current price or reference price accordingly.

A typical example of an explicit method is option pricing. This works by collecting market prices for product features in which the replacement product offer and the replaced one differ. In the case of a car, a model may have some feature, such as side airbags, that was not included in (the price for) the replaced one. The value to the consumer of this quality change is explicitly assessed as a chosen proportion of the market price for the same feature when purchased separately as an add-on for a similar car model without it.

Generally, *implicit* methods assume that price developments of other non-replaced product offers apply to the prices of a replacement.

Such an implicit method is *bridged overlap*, described below (Section 6.8.1). This method imputes a price change from the preceding month to the replacement month, for the replacement product offer, based on price changes for other product offers that were observed in both months.

Compatibility with the legal framework

Article 2a(8) of Regulation No 1749/96 states that explicit methods are in principle appropriate. However, it is also clear from the context that implicit methods are not ruled out. Namely, implicit methods are often an effective means to fulfil the stated requirement, i.e. to base quality adjustment on due evidence of a difference in significant price-determining characteristics.

Theoretical basis for implicit methods

Implicit methods assume that in case of a replacement product offer the price development of other product offers from the same consumption segment may be used to estimate that of the replacement. A theoretical basis for the validity of this assumption can be found in economic theory, where it is assumed that in a free market in a state of equilibrium, price differences between competing products at any given point in time correspond to quality differences. This follows from the law of one price, and it is further supported by the theory of revealed preferences.

To apply the theory of revealed preferences, products are seen as bundles of characteristics, i.e. quality features. When consumers pay a higher price for one bundle (i.e. product) than for another, they reveal their preference for the former over the latter. The weak axiom of revealed preferences (WARP) suggests that this preference ordering is consistent (transitive) and thus does not imply any contradictions. This axiom may or may not apply to a market, but when it does, this means that price differences at a given point in time can be used to measure quality differences without leading to contradictory results.

This conclusion provides a theoretical basis for implicit methods such as bridged overlap. The applicability of the revealed preferences theory depends on certain conditions being fulfilled. These conditions are that there has to be free competition between product offers, so that prices can react to one another and thus adapt to what consumers are willing to pay for product offers in view of their characteristics. Furthermore, consumer preferences have to be stable, and the market has to be in a state of equilibrium, with balance between supply and demand. These conditions are probably never perfectly fulfilled in reality, but in many situations they appear to be fulfilled with a good enough approximation.

A situation where the theory fails can be when a new product offer replaces one that has been available in the market for some time and is now on final sale at a discount. As the seller acts to clear stocks rapidly with a reduced price, supply and demand are not in balance for the replaced product offer.

Parallel between implicit quality adjustment and chaining with resampling

Article 2a(8) of Regulation No 1749/96 states that:

> 'A quality change does not arise when there is a comprehensive annual or less frequent revision of the HICP sample. Its inclusion shall be made by establishing the appropriate chain links. Revisions of the HICP sample do not remove the need to introduce replacement product offers without delay in between two revisions.'

When revising the sample there naturally occur many differences in product characteristics between the previous sample and the newly selected one. But the quoted passage states as a convention that these differences are not to be treated with quality adjustments like quality changes in individual replacements but are to be included by chain links.

However, in effect the chain-linking works somewhat like the implicit method of bridged overlap just described. When chain-linking, differences in product characteristics between the two samples are not shown as a price change in the index series.

6.4.5   Metadata for users

It is important that index users are provided with metadata, i.e. information on applied quality adjustment methods. The choices and performance of methods and conventions in quality adjustment and replacements can crucially affect the comparability and interpretation of results. Simple descriptive statistical tables on the frequency of quality adjustment by product category and quality adjustment method can be helpful.

The methods used to adjust specific product groups should be fully described in the HICP inventories.

6.5 Overview and definitions of quality adjustment methods

6.5.1 Definitions of methods

No quality difference

- *Direct price comparison* means that the value of the quality change is assessed as zero.

- *Explicit methods*

- *Package-size adjustment* means that the value of a change in package size, as a proportion of the price, is assessed as the relative change in package size.

- *Single-variable adjustment* means that the value of the quality change between a replaced and a replacement product offer, as a proportion of the price, is assessed as the relative change in some function of one particular characteristic of the product offers (example: a change in excess for insurance policies; see Section 12.2).

- *Option pricing* means that the value of the quality change between a replaced and a replacement product offer is assessed as some fixed proportion of the market price of features by which the two product offers differ.

- *Supported judgement* means that the value of the quality change between a replaced and a replacement product offer is calculated by using supplementary information sources.

- *Hedonic re-pricing* (or Hedonic regression for pricing of characteristics) means that the value of the quality change between a replaced and a replacement product offer is assessed as the value of characteristics by which the two product offers differ, computed from a regression equation.

- *Hedonic regression methods in general* means that the quality adjustment is in some way based on a regression equation, which expresses the price as a function of product characteristics.

- *Combined quality adjustment methods* means that the value of the quality change between a replaced and a replacement product offer is assessed using a combination of methods (see Section 6.7.7).

Implicit methods

- *Bridged overlap* means that the relative price change in a replacement since the preceding period (last month) is assessed as the relative price change since the preceding period for other product offers which were available in both months being compared.

- *Monthly chaining and replenishment* means that the aggregate relative price change between any two adjacent periods is assessed as the aggregate relative price change for the set of all product offers that are available in both those periods.

- *Backcasting* (or base price imputation) means that the relative price change in a replacement since the price reference period is assessed as the relative price change since the price reference period for product offers that are not replaced.

- *Link-to-show-no-price-change* (or automatic linking, or price change taken as quality change) means that the value of the quality change is assessed as the change in price since the preceding period (this method is forbidden as a basis for quality adjustment in the HICP, Article 5(5) of Regulation No 1749/96).

6.5.2 Applicability of methods

The choice of an appropriate quality adjustment method varies by product area. This is elaborated on in other parts of the manual. Table 6.1 gives a brief summary of the methods' pros and cons.

Table 6.1: Summary of aspects on quality adjustment methods

Method	Explicit/ Implicit	Advantages	Limitations	Remarks
Direct price comparison	(Explicitly decided)	Transparent	Overlooks quality change	For convention where needed
Package-size adjustment	E	Straightforward	Assumes proportionality	Only for modest differences
Single-variable adjustment	E	Transparent	Assumes form of variable impact	Example: Excess in insurance (14.2)
Option pricing	E	Transparent	Needs option prices	Assumption of fraction of option price needed
Supported judgement	E	Flexible	Lack of control	Lack of criteria for 'supported'
Hedonic re-pricing	E	Strong theory	Needs detailed data. Assumes regression equation	Practically, the most useful hedonic form
Other hedonic regression methods	E	Strong theory	Needs detailed data. Assumes regression equation	
Combined methods (Not strictly a separate method)	E and I	Adapts to individual conditions	Complex	E.g. to split major/ minor changes
Bridged overlap	I	Flexible. Easier than hedonics	Assumes free stable market, etc.	Not suitable for clothing or similar products
Monthly chaining and replenishment (MCR)	I	Flexible. Easier than hedonics	Assumes free stable market, etc.	Similar to bridged overlap
Backcasting	I	Computationally fits to December link	Slightly less accurate (than bridged overlap)	Other methods better

The above table is very simplified to give an overview of the main aspects. There are many different views on the methods listed above, and it is therefore not feasible to summarise all views.

Life cycle of product models

A complicating issue is how quality adjustment methods perform in relation to life cycles of product models. For example, in various product areas, product models often go on sale at more or less substantial discounts for stock clearance just before they vanish from the market. Under such circumstances, implicit methods generally cannot be used unless special precautions are applied, as these methods assume a stable market which is not present here. Particularly for products like clothing, where models are often available for only a few months, and largely at falling prices, this means that implicit methods are not applicable.

But when dealing with product model life cycles, care has to be taken also for explicit methods, including hedonic regression. For example, for hedonic re-pricing the timing and choice of data to refresh the estimates of the regression coefficients has to be planned appropriately. The estimation of regression coefficients in hedonic re-pricing should probably be based on pre-sales prices, observed before discounts were applied.

6.6 The form of quality adjustment in elementary aggregate indices

The principles for using quality adjustment in index computation

According to Article 2(17) of Regulation No 1749/96, quality adjustment makes allowance for quality change by increasing or decreasing the observed current or reference prices by a factor or an amount equivalent to the value of that quality change.

In the computation of the index, the quality adjustment can be carried out in alternative ways; either for the current price or for the reference price, and either by multiplication with a factor, or by the addition or subtraction of a monetary amount. The choice between these alternatives in practice is basically a matter of convenience based on computational routines and forms of data sources used. It is not a matter of principle for proper quality adjustment, although the different approaches can lead in some cases to different results.

Without loss of generality, the following descriptions of quality adjustment methods are given for one of the computation choices described above. This is the form where the *reference price* is *multiplied with a factor*, called quality adjustment factor (denoted *g*).

The descriptions below show how to apply quality adjustments to single product offers that are replaced. However, quality adjustments can also be applied for entire strata or elementary aggregates at the same time. This occurs when a quality change results from a change in a product specification, as in accordance with Article 2a (8) of Regulation No 1749/96. The treatment is then analogous to the quality adjustment of single product offer, the only difference being that the quality adjustment is applied to more than one product offer at the same time.

The computational setting of elementary aggregate indices

For the rest of this chapter, the quality adjustment methods will be applied to an elementary aggregate index. The elementary aggregate index can be computed as a *geometric mean of price relatives* (i.e. the Jevons index formula), or as a *ratio of arithmetic means of prices* (i.e. the Dutot index formula). These two index formulas for elementary aggregates are given in the HICP legal framework and are described in Chapter 8. The application is similar in other settings, e.g. for a weighted geometric mean of price relatives.

For simplicity of presentation, formulas in the rest of this chapter will be given for a situation where the elementary aggregate comprises the prices of five product offers.

Notation. The following notation will be used for the presentation in the different formulas. The elementary aggregate is to show the price change from the price reference period, that is (usually) the month 0 of year *t*, denoted 0*t*, to a current or comparison period being month *m* of year *t*, denoted *mt*. In the price reference period, the sample for price collection comprises five observed prices, denoted:

$$p_1^{0t}, p_2^{0t}, p_3^{0t}, p_4^{0t}, p_5^{0t}$$

The price reference period 0*t* is normally December of the preceding year, while the current period *mt* may be any month of the current year.

For reference, consider first the case where there are no replacements between the price reference period 0*t* and the current or comparison month *m* in year *t*, denoted *mt*. Then there are five corresponding observed prices in month *mt* in year *t*, denoted:

$$p_1^{mt}, p_2^{mt}, p_3^{mt}, p_4^{mt}, p_5^{mt}$$

The elementary aggregate index expressing the price change from period 0*t* to period *mt* is then computed by either of the two usual index formulas: the geometric mean index formula, or the ratio of arithmetic mean prices.

First, when the *geometric mean index formula*, or more precisely the *geometric mean of price relatives*, is used as the elementary aggregation formula, the index is computed as:

$$I^{mt} = \left(\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{p_4^{0t}} \cdot \frac{p_5^{mt}}{p_5^{0t}} \right)^{\frac{1}{5}}$$

$$= \sqrt[5]{\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{p_4^{0t}} \cdot \frac{p_5^{mt}}{p_5^{0t}}}$$

(6.6.1)

When the *ratio of arithmetic mean prices* is used as the elementary aggregation formula, the index is computed as:

$$I^{mt} = \frac{p_1^{mt} + p_2^{mt} + p_3^{mt} + p_4^{mt} + p_5^{mt}}{p_1^{0t} + p_2^{0t} + p_3^{0t} + p_4^{0t} + p_5^{0t}}$$

(6.6.2)

A case with replacement product offers — the setting for quality adjustment

Assume for the rest of this chapter that between months $(m-1)t$ and mt, replacements have been made for product offers numbers 4 and 5 in the observed sample (unless otherwise stated). This means the prices of product offers in period mt are taken as the replacement prices (of product offers) numbers 4 and 5 that were initially sampled in period $0t$. The replacements may call for quality adjustment by one of the methods described below.

Forms of a quality-adjusted index

For most methods of quality adjustment, the quality-adjusted index may be written in the following form.

For the geometric mean index, an index corresponding to equation 6.6.1, with quality adjustment, is computed as:

$$I^{mt} = \left(\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{p_4^{0t} \cdot g_4} \cdot \frac{p_5^{mt}}{p_5^{0t} \cdot g_5} \right)^{\frac{1}{5}}$$

(6.6.3)

Here g_4 and g_5 are *quality adjustment factors*, computed by one of the methods described below. They express the estimated quality change in the replacements for prices (product offers) 4 and 5. They are the factors referred to in Article 2(17) of Regulation No 1749/95, as mentioned above; here they are applied to a reference price or to the price in the price reference period.

The quality adjustment factors g_4 and g_5 are thus scale factors by which a reference price or the price reference period prices are multiplied to adjust for quality change. They are used here mainly as a technical device to conveniently describe how the quality adjustment is used computationally in the index calculation, for a given quality adjustment method.

For the alternative index formula, ratio of arithmetic means prices (see equation 6.6.2), the quality-adjusted index becomes:

$$I^{mt} = \frac{p_1^{mt} + p_2^{mt} + p_3^{mt} + p_4^{mt} + p_5^{mt}}{p_1^{0t} + p_2^{0t} + p_3^{0t} + p_4^{0t} \cdot g_4 + p_5^{0t} \cdot g_5}$$

(6.6.4)

where the quality adjustment factors g_4 and g_5 are used.

The quality adjustment factors g_4 and g_5 have a straightforward interpretation. If the number g_4 is equal to one it means that the quality is unchanged in the replacement price (product offer) of product 4 in the sample. If the number is larger than one it means improved quality, and if it is smaller than one it means deterioration in quality (it is always larger than zero).

In the index computed by equation 6.6.3 (or alternatively equation 6.6.4), the use of the numbers g_4 and g_5 compensates for the quality changes. The adjusted price $p_4^{0t} \cdot g_4$ should be approximately equal to the replacement price p_4^{mt}. So the index I_{mt} computed by equation 6.6.3 (or equation 6.6.4) will show the pure price change, not unduly disturbed by quality changes.

A remark on notation: the notation on the quality adjustment factor g has varied in the literature, as sometimes g denotes the inverse of the number it denotes here.

Quality adjustment at the aggregate level

As noted at the beginning of this section, quality adjustment can also be applied to an entire stratum or elementary aggregate at the same time, rather than to single product offers. This can occur when a product specification has changed. In such cases, the treatment is similar to the replacement of a single product offer. But in this case, the same quality adjustment factor is applied to all product offers in the aggregate concerned.

As regards practical computation routines, quality adjustments of entire elementary aggregates may operationally be performed as a modification of sub-indices rather than of prices. For example, if the same quality adjustment factor is applicable to the price reference period prices of all product offers in the elementary aggregate, then the quality adjustment can be performed by dividing the elementary aggregate index with the common quality adjustment factor. When the quality adjustment factor is the same for all product offers, then the modification of sub-indices is equivalent to the modification of prices.

An alternative form: imputed price reference prices

Alternatively, equation 6.6.3 may be written as:

$$I^{mt} \; = \; \left(\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{\hat{p}_4^{0t}} \cdot \frac{p_5^{mt}}{\hat{p}_5^{0t}} \right)^{\frac{1}{5}}$$

without the explicit use of the quality adjustment factors g_4 and g_5, but instead using *imputed* base prices:

$$\hat{p}_4^{0t} \; = \; p_4^{0t} \cdot \; g_4, \hat{p}_5^{0t} \; = \; p_5^{0t} \cdot \; g_5$$

Alternatively, in the case of the Jevons index, the price index can be expressed as the index in t–1 compared to the base period $0t$, multiplied by the quality adjusted price change between t–1 and t.

A decomposition of this type is not possible with the Dutot price index.

6.7 Explanations and examples for explicit quality adjustment methods

6.7.1 Direct price comparison

The method of *direct price comparison* means that the value of the quality change is assessed as zero.

Aliases: direct price comparison is also known as unadjusted price comparison i.e. product offers which are judged to be essentially equivalent. It means that the index computation is made without any quality adjustment.

Basic usage: direct price comparison is applicable when disregarding quality change is deemed not to yield unacceptable bias, or it is acceptable by convention (see Section 6.3.7).

Underlying assumptions: the applicability of the method rests on the assumption that quality changes are negligible.

Examples of use: a red cotton T-shirt is replaced by a blue cotton T-shirt, the only significant difference between the two being the colour. As such, the replacement is assessed as being essentially equivalent. Another example: a hammer is replaced with another very similar hammer, which does not differ in any way affecting the use, and thus it is essentially equivalent. This method is usually applied to various kinds of services.

Examples of likely A/B/C rating: the method can be rated an A method for products that are normally without notable distinguishing features, such as ordinary toilet paper. It can also be rated an A method for product areas where an estimation of quality change is conceptually unfeasible, and a B method where this estimation would be too demanding in practice.

Computation: for direct price comparison, the index is computed by equation 6.6.3 or equation 6.6.4 with the quality adjustment factors taken as:

$g_4 = 1, g_5 = 1$

For the geometric mean index, the formula for the index computation becomes:

$$I^{mt} = \left(\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{p_4^{0t}} \cdot \frac{p_5^{mt}}{p_5^{0t}} \right)^{\frac{1}{5}}$$

and for the ratio of arithmetic mean prices, it becomes:

$$I^{mt} = \left(\frac{p_1^{mt}}{p_1^{0t}} \cdot \frac{p_2^{mt}}{p_2^{0t}} \cdot \frac{p_3^{mt}}{p_3^{0t}} \cdot \frac{p_4^{mt}}{p_4^{0t}} \cdot \frac{p_5^{mt}}{p_5^{0t}} \right)^{\frac{1}{5}}$$

Comment on applicability: disregarding quality change by using the direct price comparison approach may be adequate in product areas where quality changes are deemed to be generally small or random in nature. It may also be accepted as a convention in areas where a basis for quality assessment is unavailable.

An example: the use of direct comparison for clothing material:

In month *m*-1: price for 1 metre of fabric, 90 % cotton, €16.5

In month *m*: price for 1 metre of fabric, 96 % cotton, €16.8

Quality adjusted monthly price change: 16.8 / 16.5 = 1.018

6.7.2 Package size adjustment

The method of *package size adjustment* means that the value of a change in package size, as a proportion of the price, is assessed as the relative change in package size.

Aliases: package size adjustment is also known as quantity adjustment or quantity augmenting. The method can be seen as a special case of a single-variable adjustment, or as a special case of adjustment by hedonic regression.

Basic usage: package size adjustment is applicable for adjustment of price per package in cases of modest changes in package size, where the size of the replacement package is approximately between half and double the size of the replaced package.

Underlying assumptions: the applicability of the method rests on the assumption that the consumer value of the product is proportional to the size of the package (in the sense of the quantity of contents).

Comment: strictly, package size adjustment is not a method of quality adjustment, as it consists of a rescaling of quantity units and does not concern quality characteristics of the product itself. However, package size adjustment is in a way more transparent and less problematic in terms of relevance and accuracy than quality adjustment in a proper sense. For convenience, the method is listed here among quality adjustment methods, as in practice it has a similar use in rendering observed prices comparable.

Examples of use: the weight of a branded confectionary bar originally of 50 grams is reduced to 48 grams, as such a quantity adjustment is required to reflect the underlying price change. Another example: a beer can of 33 centilitres is replaced with one of 50 centilitres of the same kind of beer. The replacement can be taken as comparable if a quantity adjustment is made.

Examples of likely A/B/C rating: the method is rated an A method where applicable i.e. in cases where recorded quantities have been observed to have changed.

Computation: assume here that in the replacement for price (product offer) no 4 in the sample, the size of the package, in e.g. kilograms or millilitres, changes from u^{0t} to u^{mt}.

Package size adjustment in the index is then computed by equation 6.6.3 or equation 6.6.4 with the quality adjustment factors taken as

$$g_4 = \frac{u^{mt}}{u^{0t}}$$ (6.7.1)

Comment on applicability: package size adjustment is generally straightforward and justifiable for modest changes in package size, as the value to the consumers essentially consists in the contents of the package, measured by the size. However, the method is not adequate for very large changes in package size, as very different quantities of a product can have notably different uses. In such cases, the method would not ensure sufficient comparability. It is important that a symmetric rule is used for increases and decreases in size. If for example a 50 % (3/2-1) increase in size is allowed, then the threshold for decreases should be 33 % (1-2/3).

Alternatives to the method are to use prices per quantity unit stated in the outlet, or to apply wide product specifications allowing a range of package sizes.

Numeric examples

Example 1: Cola, a change in bottle size

Assume that the following prices have been collected.

Table 6.2: Observed prices for cola

No	Period	
	0t	**mt**
1	1.59	1.59
2	1.25	1.25
3	1.25	0.99
4	1.10	1.49
5	0.99	0.99

Assume that between month $m - 1$ and month m, for price (product offer) no 4, a 33 cl bottle of cola was replaced by a 50 cl bottle of cola, while for price no 5, a 33 cl bottle of cola was replaced by a bottle of the same size.

Then for the method of direct price comparison, applied with the geometric mean index, equation 6.6.3 with $g_4 = 1$ and $g_5 = 1$ gives the index number $I^t = 101.42$.

For the method of package size adjustment, equation 6.6.3 gives:

$$g_4 = 50/33 = 1.15151, \, g_5 = 1$$

Plugging this number into equation 6.6.3 gives the index number $I^{mt} = 93.33$

Example 2: Products for personal care, a change in package size

In month $m - 1$: liquid soap, brand X, variety *sensitive*, 300 ml €2.39

In month m: liquid soap, brand X, variety *sensitive*, 250 ml €1.95

Quality adjusted monthly price change: $1.95 / 2.39 \times 1/(250/300) = 0.979$

6.7.3   Option pricing

The method of *option pricing* means that the value of the quality change between a replaced and a replacement product offer is assessed as some fixed proportion of the market price of features by which the two product offers differ.

Aliases: none.

Basic usage: option pricing is applicable in product areas where quality changes often consist in changes in the presence of specific product features, for which prices can be collected or estimated.

Underlying assumptions: the applicability of the method rests on the assumption that the difference in consumer value between similar product offers is equal to some given or previously estimated proportion of the price for separately purchased features by which the product offers differ.

Examples of use: the method is often used for new cars regarding minor changes, i.e. changes in features within the same car model. It has also been used for desktop computers. The method is also applicable to services consisting of components, such as package holidays and restaurant menus.

Examples of likely A/B/C rating: the method is rated an A method for new cars, regarding minor changes (see Section 12.3).

Computation: assume that the value of a quality difference is to be taken as the given proportion of the market price for the differing features, where ρ is a positive number not larger than one. Then assume that, in the price of the replacement product offer no 4 in the sample, the replacement product offer (but not the replaced product offer) has features of a market price of c. The price c is stated in euro, or in monetary units in the currency of the country in question, and it pertains to the price reference period.

In option pricing, the index is then computed by equation 6.6.3 or equation 6.6.4 with the quality adjustment factors taken as:

$$g_4 = 1 + \frac{\rho \cdot c}{p_4^{(m-1)t}}$$ (6.7.2)

and similarly for g_5.

If instead features were present in the replaced product offer but have been taken away in the replacing product offer, then the prices of those features should be taken as negative numbers in the computation.

A critical issue for this method is the choice of the proportion. This number $\rho \leq 1$ works as a *reduction factor* by which the value of the added or subtracted features is scaled down from their observed market value.

The reduction factor ρ is very often fixed to one half. This means that 50 per cent of the market price of the option is taken as the value of the corresponding quality difference. With this 50 per cent reduction, it is assumed that probably not all buyers of, for example, a car, really want a particular feature and would be willing to pay the full market price for it. In other words, the average consumer value of a feature as a compulsory part of a package (the car) is presumably smaller than the consumer value of the same feature when it is bought separately by those consumers who specifically want that feature.

The choice of the reduction factor ρ depends on a judgement, even if some empirical support may be available. In particular, the choice of 50 per cent as the factor for cars seems to be a widely established convention. There is some intuition and plausibility to this choice, in addition to it being a midway compromise. Namely, the time for including a new feature (option) in the price of the car could be when the car dealers feel that a majority of buyers have become willing to pay for it.

Comment on applicability: in the case of new cars, the method is useful to quality adjust for minor changes such as the addition of additional features like extra airbags, a higher quality stereo, climate control or changed warranty conditions. Changes in such features are to be treated as quality changes to the extent that they are of lasting consumer value and not temporary fashion (see Section 6.3.5). However, features like type or colour of paint, special alloy wheels and leather seats can probably be seen as fashion and thus are more questionable to quality adjust for (see Section 12.3).

Usually market prices can be collected for the features (options) in question when bought as extras to a similar car model without them. Those prices can be used as a basis for quality adjustment by option pricing.

Example: assume that the following prices have been observed for car models:

Table 6.3: Observed prices for cars

No	Period		
	0t	**(m-1)t**	**mt**
1	14 900	14 900	14 900
2	26 990	26 990	26 990
3	20 900	19 900	19 900
4	17 900	17 900	19 690
5	19 000	19 000	19 000

Assume that for price (product offer) 4, the replacing product offer has two features that were not present in the previous model. For the previous model, those features were, however, available as separate options, at the prices of €298 for one of them and €699 for the other. For price (product offer) 5, there were no differences in terms of distinguishing features between the replaced and the replacement model.

Then for the method of direct price comparison, equation 6.6.3 with $g_4 = 1$ and $g_5 = 1$ gives the index $I^{mt} = 100.93$.

For the method of option pricing, with reduction factor $\rho = 0.5$, equation 6.7.2 gives:

$$g_4 = 1 + \frac{0.5 \cdot (298 + 699)}{17\ 900} = 1.027849, g_5 = 1$$

Plugging these numbers into equation 6.6.3 gives the index $I^{mt} = 100.38$.

6.7.4   Supported judgmental quality adjustment

The method known as *supported judgmental quality adjustment* means that the value of the quality change between a replaced product offer and the one replacing it is calculated by using supplementary information sources.

Aliases: expert judgement is a term for one form of supported judgmental quality adjustment.

Basic usage: supported judgmental quality adjustment is applicable in product areas where more formal methods are not available, and where supporting instructions and information is available, so that a quality adjustment process can be designed.

Underlying assumptions: the applicability of the method rests on the assumption that the difference in consumer value between product offers can be calculated by using supplementary information sources in one way or another.

The method is in some ways similar to that of option pricing just described. However, in contrast to option pricing, the supplementary information is here not restricted to the prices for options taken from observed price lists. The value of the quality difference can be calculated in more flexible ways — using a broader source of supplementary information, as described below.

The examples below use calculation procedures that are designed for specific kinds of quality change in certain product areas. Somewhat more controversial is whether the supplementary information sources may involve assessments involving the judgement of product experts or the judgement of price collectors. The regulations do not say anything that might exclude the use of such sources. However, for such practices to be appropriate, it is crucial that the assessments are supported by adequate information, instructions, calculation templates and validation procedures, so as to properly control the process and prevent undue arbitrariness. Ideally, the supporting material could make the process work somewhat like option pricing.

Examples of likely A/B/C rating: the method can be rated a B method for complex products where the required supplementary information sources are available and other methods are not applicable in practice.

Computation: the computation is here basically the same as for option pricing as described above, by equation 6.6.3 or equation 6.6.4 with equation 6.7.2. The computations can be adapted to product-specific conditions as required.

Comment: no criteria have been agreed for the requirements of supported judgements.

The following three examples show how calculations can be used for supported judgement.

Example 1: Energy consumption

An example of the value of a quality change expressed in monetary terms is if a replacement product offer of an electric appliance, for example, has lower power consumption than the replaced one. The monetary benefit caused by the lower power consumption can be calculated by multiplying a current average price of the energy saved per year by the anticipated duration of use of the appliance. In practical application, the change in the energy label can be used (see Section 6.3.5).

Example 2: Comparable models

An example of the use of comparable models (to determine the value of the quality change) is where a manufacturer markets two models simultaneously that differ in one characteristic only — the net capacity of two otherwise identical freezers, for example. If it can be assumed that prices have been set in a competitive market, it would in this case be justified to take the price difference between the two freezers as an estimate of the value of the quality difference — because the price difference can be attributed to the characteristic in question. This means it is possible to determine the price for a certain amount of additional capacity. The assumption here of a proportional relationship between capacity and consumer value in monetary terms can probably be taken as acceptable.

Example 3: Fuel efficiency of new cars

Another example of the application of supported judgmental quality adjustment is the calculation of the quality difference regarding the fuel efficiency of new cars. In this case hypothetical values of some parameters are assumed: the number of kilometres driven per year is set at 15 000, and the number of years of use that the consumer has in mind at the time the car is purchased is set at 5 years. Given these assumptions, the value of the difference between the replaced car and the replacement model where all other characteristics of the models are equal, can be calculated as follows. Model A consumes 8.0 litres per 100 km and Model B 7.5 litres per 100 km. Suppose that the actual fuel price is €1.00 per litre. Then the option price for enhanced fuel efficiency can be calculated as:

$(8 - 7.5) / 100 \times 75\,000 \times €1.00 = €375.00$

(See Section 12.3.)

6.7.5   Hedonic regression for hedonic re-pricing

The method of *hedonic re-pricing* means that the value of the quality change between a replaced and a replacement product offer is assessed as the value of characteristics by which the two product offers differ, computed from a regression equation.

Aliases: hedonic re-pricing is also known as hedonic regression for pricing of characteristics, the indirect hedonic method or hedonic regression for price imputation. It is also referred to as hedonic adjustment by calculating implicit prices of characteristics.

Basic usage: hedonic re-pricing is applicable in product areas where detailed data on product characteristics can be collected in the price collection, and where a regression function can be assumed to adequately describe the dependence of the price on product characteristics.

Hedonic methods are highly regarded for their strong scientific basis and well-controlled accuracy. In particular, the method of hedonic re-pricing has been found to be practically useful for official price indices, though to a somewhat limited extent. The limitations are due to its relatively heavy resource requirements in terms of the need for qualified staff, the design and maintenance of regression models, and the availability of detailed input data. Uncertainty in choices between options within the method is also of some concern.

Underlying assumptions: the applicability of the method rests on the assumption that at a given period in time, a regression function expresses how the prices of different models (product variants) depend/develop, in relation to the characteristics of the models observed.

Specifically, the price p is assumed to depend on some variables $z_{\text{char}.1}, z_{\text{char}.2}, \ldots, z_{\text{char}.k}$ corresponding to quality-related product characteristics, which can be expressed by an equation like this:

$$ln\, p = b_0 + b_{\text{char}.1}\, z_{\text{char}.1} + b_{\text{char}.2}\, z_{\text{char}.2} + \cdots + b_{\text{char}.k}\, z_{\text{char}.k} + \varepsilon \qquad (6.7.3)$$

Here ln stands for the natural logarithm, $b_{\text{char}.1}, \ldots, b_{\text{char}.k}$ denote parameters to be estimated from data, and ε denotes a *residual* term capturing a component of the price that cannot be explained by observed product characteristics. The parameters $b_{\text{char}.1}, \ldots, b_{\text{char}.k}$ are known as *regression coefficients* or *hedonic coefficients* and express the consumer value of the corresponding product characteristics.

Comment: the following treatment of this method is relatively long compared to the treatment for other methods. This is because while the method is potentially useful, it is generally still of limited use, probably because it is not well-known. For further theoretical explanations and references, see the ILO CPI Manual ([41]), and the Handbook on Hedonic Price Indexes, by J. Triplett ([42]).

Example of use: hedonic re-pricing is often used for electronic goods like computers and cameras (see Section 12.9), and also for appliances such as washing machines, and for clothing (see Section 12.7). It is also applied for used cars (but not for new cars, see Chapter 12.3) and could be useful for books, primarily to reduce the variance caused by following bestseller lists.

Examples of likely A/B/C rating: the method may be rated an A method for technically complex products like electronic goods, appliances and used cars (see Sections 12.3 and 12.9).

Computation: assume that there are three quality-related product characteristics to be adjusted for, i.e. $z_{\text{char}.1}, z_{\text{char}.2}, z_{\text{char}.3}$, so that the equation 6.7.3 takes the form:

$$ln\, p = b_0 + b_{\text{char}.1}\, z_{\text{char}.1} + b_{\text{char}.2}\, z_{\text{char}.2} + b_{\text{char}.3}\, z_{\text{char}.3} + \varepsilon \qquad (6.7.4)$$

The computation is carried out in two steps:

Compute estimates $\hat{b}_{\text{char}.1}, \hat{b}_{\text{char}.2}, \hat{b}_{\text{char}.3}$ of the regression coefficients. This is typically done at an early stage, in the base period or earlier, using data available then.

In the subsequent replacement situations, use the coefficient estimates $\hat{b}_{\text{char}.1}, \hat{b}_{\text{char}.2}, \hat{b}_{\text{char}.3}$ to compute the quality adjustment factors g_4 and g_5, to be used in the index computation by equation 6.6.3 or 6.6.4.

In step (a) the coefficient estimates $\hat{b}_{\text{char}.1}, \hat{b}_{\text{char}.2}, \hat{b}_{\text{char}.3}$ are usually computed by some standard software package for statistical analysis, using a statistical estimation technique known as ordinary least squares. The computational procedure for ordinary least squares can readily be stated mathematically in a *closed form*, found in textbooks on regression analysis, but the practical work is hidden inside the computer. This computation of the coefficient estimates is based on observed data on prices and quality-related variables for sampled models available in, for example, the base period. In practice, the estimation of the coefficients can be based on a larger data set than the data used for index compilation in the base period in order to obtain more robust results.

For step (b), assume that by the replacements for the prices (product offers) no 4 and 5, the values of the quality-related variables changed from $z_{\text{char}.2,\text{model}.4}$ to $z_{\text{char}.2,\text{model}.4}$ et cetera. The quality adjustment factors are then computed as:

$$g_4 = e^d$$

where:

$$d = \hat{b}_{\text{char}.1}\left(z_{\text{char}.1,\text{model}.4\prime} - z_{\text{char}.1,\text{model}.4}\right)+$$
$$+ \hat{b}_{\text{char}.2}\left(z_{\text{char}.2,\text{model}.4\prime} - z_{\text{char}.2,\text{model}.4}\right)+ \qquad (6.7.5)$$
$$+ \hat{b}_{\text{char}.3}\left(z_{\text{char}.3,\text{model}.4\prime} - z_{\text{char}.3,\text{model}.4}\right)$$

and similarly for g_5.

([41]) ILO/IMF/OECD/UNECE/Eurostat/The World Bank (2004), *Consumer Price Index Manual: Theory and Practice,* Geneva: International Labour Office.

([42]) Triplett, J. (2006), Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products, Paris: OECD Publishing.

Comment on applicability: the quality-related variables $z_{char.1}$, $z_{char.2}$, $z_{char.3}$ may be of two different kinds:

- *Continuous variables*, or quantitative variables, measure quantifiable product characteristics, such as size, engine power or speed.

- *Dummy variables* are equal to 1 or 0 to represent whether a particular product feature is present or not, such as Dolby surround sound in a TV set, a hard-cover on a book, a lining in a jacket, or a DVD writer/recorder in a computer.

A hedonic regression equation such as equation 6.7.4 is said to be of *semi-logarithmic* form, as the equation uses the logarithm of the price. Alternatively, a *double-logarithmic* form is often used, where the equation uses logarithms both of the price and of continuous quality-related variables.

The estimated hedonic coefficients can be given an independent interpretation. Let z_1 be a dummy variable, being equal to 1 when a certain product feature is present and equal to 0 when it is not. Then a product model having the feature is expected to have a $e^{\hat{b}_{char.1}}$ times higher price than an otherwise similar model without the feature. For continuous variables there is a corresponding interpretation. The interpretation of regression coefficients is useful in procedural tests and data validation, to highlight potentially implausible outcomes. So in that way the regression coefficients express the value of quality features. Now note that according to the procedure in this method, the coefficients were estimated in an earlier period, while they are applied in quality adjustment for replacements in the current period. This means that the method inherently assumes that the consumer value of various product features does not change notably between the earlier period and the current period.

However, in reality the consumer value of product features may change over time, at least slowly and sometimes perhaps rapidly, as consumer preferences change. For this reason, the regression estimates must be re-estimated regularly at suitable time intervals.

There are several more or less intricate decisions to be made in the design of a hedonic application. Decisions must be taken and assessments made on issues such as these:

- How many and which quality-related variables to include in the regression equation.

- Whether to use another (finer or coarser) stratification when estimating the regression coefficients than when computing the index.

- How frequently to re-estimate the regression coefficients.

- Whether to weight the prices when estimating the regression coefficients.

- Which function form to use: semi-logarithmic, double-logarithmic or other.

- Whether valid or spurious results are obtained.

- Whether the method improves the accuracy of the index so much that it outweighs the often relatively high cost for design work and for collection of quality-related data.

These decisions require both sound knowledge of the product area concerned and good regression analysis skills. Running a regression analysis on the computer is not difficult, but to make sure that the procedure is adequate is very demanding.

Remarks on wording: 'regression equation', of which equation 6.7.4 is an example, is often referred to as a *regression model* or a *hedonic model*. The word model is then used in the sense of a *statistical model*, which is an assumed mathematical representation of the defining magnitudes (parameters) to be estimated from observed data. This use of the word *model* should not, of course, be confused with 'model' in the sense of product variety.

Numeric examples

Example 1: Observed prices and quality variables

Assume that the following prices and quality-related data have been observed.

Table 6.4: Observed prices and quality variables

No	Period							
	0t				mt			
	Price	$z_{char.1}$	$z_{char.2}$	$z_{char.3}$	*Price*	$z_{char.1}$	$z_{char.2}$	$z_{char.3}$
1	390	23	0	0	390	23	0	0
2	480	39	0	0	519	39	0	0
3	700	51	1	0	650	51	1	0
4	550	39	0	1	598	39	1	1
5	490	45	0	0	690	53	0	0

Here there are three quality-related variables, of which one is continuous, i.e. $z_{char.1}$, and two are dummy variables, $z_{char.2}$ and $z_{char.3}$.

Here for the method of direct price comparison, equation 6.6.2 with $g_4 = 1$ and $g_5 = 1$, gives the index $I^{mt} = 108.98$.

Now assume that equation 6.7.4 has been considered adequate for the situation. Then first compute the coefficient estimates $\hat{b}_{char.1}, \hat{b}_{char.2}, \hat{b}_{char.3}$ from the observations for period $0t$. A standard computer program for statistical analysis yields:

$$\hat{b}_{char.1} = 0.01091$$

$$\hat{b}_{char.2} = 0.27232$$

$$\hat{b}_{char.3} = 0.16210$$

It must be stressed that in an actual application, the estimation of the regression coefficients from such a small data set as just five observations would never be made, as the precision then becomes unacceptably poor. So the computation of the coefficient estimates just presented is merely an illustrative example for demonstration of the computation technique. In the rest of this example, it could of course be imagined that the coefficient estimates were computed from some larger data source.

For the interpretation of e.g. $\hat{b}_{char.2}$, note that $e^{\hat{b}_{char.2}} = e^{0.27232} = 1.313$. This means that a model that has the feature indicated by $z_{char.2} = 1$ is expected to have a price 31.3 per cent higher than a model without that feature (i.e. with $z_2 = 0$). This type of interpretation is useful to check that the hedonic regression analysis works in a way that makes sense.

To apply the coefficient estimates for the actual quality adjustment in the replacement situation, use equation 6.7.5 to compute:

$$g_4 = e^{\,0 + 0.27232 \cdot (1 - 0)} = 1.313007$$

$$g_5 = e^{\,0.01091 \cdot (53 - 45) + 0} = 1.091202$$

Plugging these numbers into equation 6.6.3 gives the index $I^{mt} = 101.42$.

Example 2: Rents, the use of the hedonic re-pricing method when replacing dwellings

Using *all* the data* from a rent survey, the following hedonic regression has been estimated:

Table 6.5: Rents data

Variable	Categories	Comments	Coefficient
Constant			5.01
Location	1 = West		-0.168
	2 = East		-0.293
	3 = Centre	Reference category	
	4 = North		- 0.448
	5 = South		- 0.258
Floor area		Transformed into logarithm	0.475
Year of the signature of the contract**	<= 2000		-0.363
	2001-2005		-0.209
	2006-2010		-0.124
	>= 2011	Reference category	
Year of construction	<= 1960		-0.192
	1961-2000		-0.080
	2001-2014	Reference category	
Type of dwelling	Apartment		-0.063
	House		
Number of rooms			0.314

* It is not possible to present the underlying data due to the size of the dataset.

** This variable is used in the regression to improve the model, but it will not be used to calculate the adjustment factor, as it is not a characteristic of the dwelling.

In month *m*-1: apartment in the south, 60 m2, year of construction 1961-2000, 2 rooms, rent €900 per month.

In month *m:* replacement apartment in the west, 50 m2, year of construction 2005, 1 room, rent €700 per month.

Estimation of the dwelling in *m*-1:

5.01-0.258 +*ln* (60) × 0.475-0.080-0.063+2 × 0.314 = 7.1818

Estimation of the dwelling in *m*:

5.01-0.168+*ln*(50) × 0.475-0.063+0.314 =6.9512

Monthly price change with *no* quality adjustment: 700/900 = 0.777

Quality adjusted monthly price change*:* 700/900 × 1/[exp (7.1818)/exp (6.9512)]=0.98

6.7.6   Hedonic regression methods in general

In general, *hedonic regression method* means that the quality adjustment is in some way based on a regression equation, which expresses the price as a function of product characteristics.

Aliases: different hedonic methods are known as the direct time dummy method, the direct characteristics method and the hedonic method with trend function.

Basic usage: hedonic regression methods in general are applicable under conditions similar to the preceding method but in other forms. Such other forms are often applied in special studies rather than regular index production.

Underlying assumptions: generally, hedonic methods rest on some assumption that somehow a regression function expresses how the prices of different models (product variants) depend on characteristics of the models.

Hedonic methods other than the preceding one often estimate the index as a parameter in the regression model and thus deviate from the usual index formulas. As an example, a simple form of the direct time dummy method may be mentioned. The regression equation is analogous to equation 6.7.4 and may be written as:

$$ln\, p = b_0 + b_{\text{char.1}} z_{\text{char.1}} + b_{\text{char.2}}\, z_{\text{char.2}} + \cdots + b_{\text{char.}k}\, z_{\text{char.}k} + b_{\text{time}}D + \varepsilon$$

In contrast to equation 6.7.4, this equation is assumed to hold for both the base period and the current period simultaneously, not just in a given period. Therefore, this equation involves an additional dummy variable *D*, called *time dummy*, which is equal to 0 or 1 to indicate whether the price was collected in the base period b or in the current period *t*. Here b_{time} is a regression coefficient to be estimated from collected data.

Examples of use: for the HICP, the preceding method, hedonic re-pricing, is normally used rather than other hedonic methods.

Computation: for the *direct time dummy method*, a regression analysis is carried out in one single run over data from both the base period and the current period simultaneously. The regression analysis produces an estimate of the regression coefficient b_{time} for the time dummy variable. The index is obtained directly by exponentiation, that is,

$$I^{mt} = e^{b_{\text{time}}}$$

If the index is compiled over several periods, then a dummy variable for each of the periods contained in the time window can be included in the regression. Alternatively, the time dummy index can be compiled over two adjacent periods whose resulting price change is then chained.

Comment on applicability: the direct time dummy method has been used in academic studies but not so much in regular index production, and this is not without reason. This method appears less transparent than that of hedonic re-pricing. Additionally, in the successive production of a series of index numbers in real time, inconsistencies may result between the regression analyses that are re-run for each new period. The direct time dummy method also appears to be less robust when there are changes in consumer preferences.

Generally, there are potentially several different possibilities to devise quality adjustment methods that rely on hedonic regression in some form. The idea of the direct time dummy method was described here in a simple form only, with just two periods compared. In its general form, this method is applicable to an arbitrary number of periods, to retrospectively estimate an entire series of index numbers in one run of the regression analysis. The retrospective perspective is not so relevant to regular index production in real time, but retrospective studies may be useful for evaluations of other quality adjustment methods.

An alternative approach to retrospective computations over a series of time periods is to use a regression equation with a trend function, instead of dummy variables for several periods. The estimation may preferably be made by a *repeated measurements* technique, accounting for the repeated appearance of the models in more than one period. This idea may be useful for retrospective or special studies, to achieve acceptable precision in cases where replacements are frequent but where the sample is small in each period.

6.7.7 Combined methods of quality adjustment (a mainly explicit method)

Occasionally, two or more quality adjustment methods are combined in practice. A frequently used approach is to make a distinction between minor and major quality changes. For example, option pricing may be applied for minor changes and bridged overlap for major changes. This solution is used in many countries for new cars.

In this solution, an explicit quality adjustment method is combined with an implicit one. In a way, the approach is primarily explicit, as the final choice of method for a specific product is governed by characteristics of the latter. The definition of minor and major changes depends on the product area and can be determined by product-specific guidance and conventions. The approach is adaptive, in the sense that the final choice between optional methods depends on observed characteristics of sampled products, following pre-specified criteria.

Another kind of combined method is direct comparison in bestseller lists. This is used for products like books and CDs and DVDs. Optionally, hedonic regression can also be involved to reduce the variance caused by the bestseller list.

6.8 Explanations and examples of implicit quality adjustment methods

The variants among implicit methods may look partly similar to each other, but they have distinguishing features making them suitable under different conditions. The following table summarises the main implicit methods.

Table 6.6: Overview of main implicit methods

Method	Section	Source of price change ('bridge')	Comment	Use
Bridged overlap	6.8.1	Product offers in the same elementary aggregate (EA)	Generic implicit form	Competitive market
Overall mean imputation	6.8.1	All product offers in the same EA	Special case of bridged overlap	Homogeneous EA
Targeted mean imputation	6.8.1	Selected product offers in the same EA	Special case of bridged overlap	Heterogeneous EA
Class mean imputation	6.8.1	Quality adjusted replacement product offers in the same EA	Special case of bridged overlap	For rich supply of price data
MCR	6.8.2	All product offers in the same EA	In effect similar to overall mean imputation	Homogeneous EA
Backcasting	6.8.3	All product offers in the same EA, price change since December	Less up-to-date	Where computationally fit

6.8.1 Bridged overlap

The method of *bridged overlap* means that the relative price change in a replacement since the preceding period (last month) is assessed as the relative price change since the preceding period for other product offers.

Aliases: bridged overlap is in some forms also known as mean imputation, sometimes further specified as overall mean imputation versus targeted mean imputation [43].

Basic usage: bridged overlap is applicable in product areas where the underlying assumption is deemed not to yield unacceptable bias.

Underlying assumptions: the applicability of the method rests on the assumption that the aggregate used for imputation has price changes representative of pure price changes. See Section 6.6.3.

Comment: the underlying assumptions can be violated where sales discounts occur, as they disrupt the market equilibrium and are liable to bias the index downwards. The problem becomes apparent when a discounted product offer is replaced by one with a *normal* higher price. Then an imputation with an aggregate with mainly unchanged product offers can result in an obvious downward bias, as the price increase due to the return to a normal price level is eliminated.

As such, where sales discounts occur particular care must be taken to prevent them from disturbing the method. A solution could be to adjust the price of the replaced product offer to its pre-sales level before performing the quality adjustment, or instead to allow for direct comparison with a sufficiently similar replacement. Moreover, sales prices may disrupt the computation of the bridge. A possibility could be to apply targeted mean imputation (see below), in such a way as to exclude discounted prices from use in imputation.

A related drawback of the method is that it does not capture *hidden* price increases when a new model is introduced.

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[43] In Triplett, J. (2006), Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products, Paris: OECD Publishing, it is referred to as the IP-IQ method.

Examples of use: the method is useful in a wide area of goods and services, including electronic goods, household appliances, new cars (major changes) and rents (if they are free market prices).

Examples of likely A/B/C rating: the method can be rated an A or B method for technically complex products like electronic goods and appliances, and cars regarding major changes (see Sections 12.3, 12.9).

Computation: in the case of the geometric mean index (the Jevons formula), use of bridged overlap means that the index is computed by equation 6.6.3 with the quality adjustment factors taken as:

$$g_4 = \frac{p_4^{mt}}{p_4^{(m-1)t}} \cdot \left(\frac{p_1^{(m-1)t}}{p_1^{mt}} \cdot \frac{p_2^{(m-1)t}}{p_2^{mt}} \cdot \frac{p_3^{(m-1)t}}{p_3^{mt}} \right)^{\frac{1}{3}} \tag{6.8.1}$$

and similarly for g_5.

It may be practical to use an alternative recursive computation which here takes the simple form:

$$I^{mt} = I^{(m-1)t} \cdot \left(\frac{p_{1)}^{mt}}{p_1^{(m-1)t}} \cdot \frac{p_{(2)}^{mt}}{p_2^{(m-1)t}} \cdot \frac{p_{(3)}^{mt}}{p_3^{(m-1)t}} \right)^{\frac{1}{3}} \tag{6.8.2}$$

and gives the same result as equation 6.8.1.

To use the bridged overlap method in the case of the ratio of arithmetic mean prices (the Dutot formula), it is most practical to apply a corresponding recursive computation, which here becomes:

$$I^{mt} = I^{(m-1)t} \cdot \frac{p_1^{mt} + p_2^{mt} + p_3^{mt}}{p_1^{(m-1)t} + p_2^{(m-1)t} + p_3^{(m-1)t}} \tag{6.8.3}$$

Remark: it may be noted that the quality adjustment factors corresponding to equation 6.8.3 become rather complicated to express and are dependent on all prices.

The method of bridged overlap exists in various alternative forms.

Alternative forms, option (i) — use of both non-replaced and replaced product offers for bridging: in the form of bridged overlap described in the computation above, the non-replaced product offers are used for the bridging. An alternative form of the method bridges by using both the non-replaced product offers and some replaced product offers. Namely, in the alternative form the bridge also includes replacement product offers treated with direct comparison or possibly an explicit method of quality adjustment.

Assume that the replacement product offer 5 is treated with direct comparison, so that $g_5 = 1$. Then the use of this alternative form of bridged overlap gives for replacement product offer 4, instead of equation 6.8.1, the quality adjustment factor:

$$g_4 = \frac{p_4^{mt}}{p_4^{(m-1)t}} \cdot \left(\frac{p_1^{(m-1)t}}{p_1^{mt}} \cdot \frac{p_2^{(m-1)t}}{p_2^{mt}} \cdot \frac{p_3^{(m-1)t}}{p_3^{mt}} \cdot \frac{p_5^{(m-1)t}}{p_5^{mt}} \right)^{\frac{1}{4}}$$

It may be noted that this form of the method is less automatic than the form using only non-replaced product-offers for the bridge. Namely, this form of bridged overlap involves individual judgements on how to treat each replacement product offer: whether to adjust by bridged overlap, or to use direct comparison or some other method.

Alternative forms, option (ii) — use of a single product offer for bridging: an alternative form of bridged overlap uses the price of just one non-replaced product offer for the computation of the quality adjustment factor g_4, and not all non-replaced product offers as equation 6.8.1 does.

Assume that the non-replaced product offer 3 has been chosen for this.

In using this alternative variant of bridged overlap, the index is then computed by equation 6.6.3 or 6.6.4, with the quality adjustment factors taken as:

$$g_4 = \frac{p_{4'}^{mt}}{p_4^{(m-1)t}} \cdot \frac{p_3^{(m-1)t}}{p_3^{mt}} \tag{6.8.4}$$

and similarly for g_5.

Alternative forms, option (iii) — targeted mean imputation: other alternative forms may be a type of compromise between equation 6.8.1 and equation 6.8.4, by bridging using a restricted subset of product offers that are similar to the replaced product offer and the replacement product offer. This is targeted mean imputation, in contrast to the overall mean imputation of equation 6.8.1, which bridges by use of all (non-replaced) product offers in the sample.

Comment on applicability: the different forms of bridged overlap use a common idea. The idea is to assess the price change since the last period for a replacement product offer as the price change for a bridge of other product offers. Thus other product offers bridge over the break in the price series of a replaced one. Different forms of the method may define the bridge by using a wider or narrower class of other product offers in the bridge. For example, in equations 6.8.1 and 6.8.3 all non-replaced product offers in the elementary aggregate are used for the bridge, while in equation 6.8.4 just one non-replaced product offer is used.

There is an inherent assumption that the value of a quality difference between product offers available in the same period are equal to the price difference between them. In bridged overlap this condition is inherently used both for the quality difference between the replaced product offer and the bridge in the preceding month $(m - 1)t$, and for the quality difference between the bridge and the replacing product offer in the current month (mt).

The applicability of bridged overlap requires that the assumption now mentioned can be deemed to hold, or possibly be acceptable as a convention. This issue has to be judged for each product area. More loosely, the method can also be defended on the grounds of *neutrality,* in that, where applicable, it yields no obvious or unacceptable bias.

Design in practice: the suitable choice between variant methods, such as between overall mean imputation and targeted mean imputation, varies between product areas. Targeted mean imputation has the advantage of possibly giving imputations that may be more suitable for replacements in heterogeneous aggregates. Overall mean imputation, in turn, has the advantage of being more stable in small aggregates. In small aggregates, it is also possible to use a higher aggregate for imputation, for adequate stability.

Example 1: Bridged overlap

Assume that the following prices have been observed.

Table 6.7: Price observations used in bridged overlap

No	Period		
	0t	(m-1)t	mt
1	390	390	390
2	480	480	519
3	700	650	650
4	550	550	598
5	490	490	690

Then for the method of direct price comparison, equation 6.6.3 with $g_4 = 1$ and $g_5 = 1$ gives the index $I^{mt} = 108.98$.

For the method of bridged overlap, equation 6.8.1 gives $g_4 = 1.059326$, $g_5 = 1.371969$. Plugging these numbers into equation 6.6.3 gives the index number $I^{mt} = 101.13$.

Similarly, the alternative variant of the method using equation 6.8.4 gives $g_4 = 1.087273$, $g_5 = 1.408163$, leading to the index number $I^{mt} = 100.08$.

Variants: simple overlap, overall mean imputation, targeted mean imputation, class mean imputation.

Example 2. Refrigerators, the use of bridged overlap

In month *m*-1*:* fridge freezer, brand X, energy label A+, €499

In month *m*+1*:* fridge freezer, brand Y, energy label A++, €599

Monthly price change with no quality adjustment: 599/499 = 1.20

Quality adjusted monthly price change based on the average price change of the other fridge freezers in the sample: 1.007.

6.8.2 Monthly chaining and replenishment

The method of *monthly chaining and replenishment* means (MCR) that the aggregate relative price change between any two adjacent periods is assessed as the aggregate relative price change for the set of all product offers that are available in both those periods. It involves a complete resampling of available product offers each month.

Aliases: monthly chaining and replenishment is also known as monthly chaining and resampling, or multi-period overlaps.

Basic usage: monthly chaining and replenishment is applicable in product areas where the underlying assumption is deemed not to yield unacceptable bias.

Underlying assumptions: the applicability of the method rests on the assumption that on average the prices of competing product offers move in parallel at levels corresponding to their consumer value (quality). See Section 6.6.3.

Comment 1: using chaining within years might technically seem to deviate from the principle of a fixed-basket index. However, a distinction has to be made between the target of the index and the means to accomplish this. The target is a fixed-basket index with the consumption segments as the fixed basket objects. The method of monthly chaining and replenishment has proved to be an efficient means to attain this target, under suitable conditions.

Comment 2: in its original form, the method of monthly chaining and replenishment involves a complete monthly resampling of available product offers in sampled outlets. A simplified form of the method involves a fixed number of currently popular product offers instead of a complete monthly resample in each sampled outlet. A downward drift may occur if the product offers systematically exit the market at a discounted price.

Examples of use: the method can be used for products like electronic goods.

Examples of likely A/B/C rating: the method may be rated as an A- or B method for technically complex products like electronic goods and appliances.

Computation: the computation is the same as the recursive form for bridged overlap — that is equation 6.8.2.

However, assume now that a model not previously available, labelled no 6, is introduced at time $(m-1)t$ and is still available at time mt, at prices $p_6^{(m-1)t}$ and p_6^{mt} .

In the case of the geometric mean index (the Jevons formula), use of monthly chaining and replenishment means that the index is computed using the following recursive formulation:

$$I^{mt} \;=\; I^{(m-1)t} \cdot \left(\frac{p_1^{mt}}{p_1^{(m-1)t}} \cdot \frac{p_2^{mt}}{p_2^{(m-1)t}} \cdot \frac{p_3^{mt}}{p_3^{(m-1)t}} \cdot \frac{p_6^{mt}}{p_6^{(m-1)t}} \right)^{\frac{1}{4}}$$

(6.8.5)

Comment on applicability: as may be noticed, the method of monthly chaining and replenishment is in a way very similar to bridged overlap. Essentially, the difference lies in the way the sample is maintained. In using monthly chaining and replenishment, the sample is continuously renewed not by one-to-one replacements of previous product offers with new ones but instead by taking in new models as they become available, without regard to the previous models sampled.

This is a practical method similar to bridged overlap, but with the advantage of a continual update of the sample. The simplified form without full monthly resampling is particularly convenient. But like bridged overlap, it depends on market conditions; it may fail where discounts are frequent. For small sample sizes and under some circumstances, the method may possibly give the index series a larger random variation than is the case with usual one-to-one replacements and bridged overlap.

6.8.3 Backcasting (base price imputation)

The method of *backcasting* means that the relative price change in a replacement since the price reference period is assessed as the relative price change since the price reference period for product offers that are not replaced.

Aliases: retrapolation. Backcasting is sometimes known as base-price imputation, a somewhat vague term which might also be used in a more general sense.

Basic usage: backcasting is applicable in product areas where the underlying assumption is deemed not to yield unacceptable bias.

Underlying assumptions: the applicability of the method rests on the assumption that product offers of different kinds are expected to have on average the same price development.

Examples of use: the method is sometimes used for various product areas as a simple proxy when other methods are not practically available. However, bridged overlap and monthly chaining and replenishment are preferable and should in general be practicably feasible.

Comment: the method may look a little like bridged overlap, with the difference that instead of going back to the previous month, it goes all the way back to the price reference period (the previous December) for imputing the price change for other product offers. A fundamental difference is that the imputed price changes in the *bridge* of bridged overlap extends over a minimal time span only and are only based on the most recent price observations, while those used in backcasting span over a longer time and rely on older price observations. Thus backcasting in a way sacrifices some accuracy for some possible computational convenience in production systems that do not easily allow for month-to-month imputations.

Computation: in the case of the geometric mean index (the Jevons formula), use of backcasting means that the index is computed by equation 6.6.3 with the quality adjustment factors taken as:

$$g_4 \;=\; \frac{p_4^{mt}}{p_{4i}^{0t} \cdot I^{(m-1)t} \cdot \left(\dfrac{p_1^{mt}}{p_1^{(m-1)t}} \cdot \dfrac{p_2^{mt}}{p_2^{(m-1)t}} \cdot \dfrac{p_3^{mt}}{p_3^{(m-1)t}} \right)^{\frac{1}{3}}} \qquad (6.8.6)$$

and similarly for g_5.

In the case of the ratio of arithmetic mean prices (the Dutot formula), use of backcasting means that the index is computed by equation 6.6.4, with the quality adjustment factors taken as:

$$g_4 \;=\; \frac{p_4^{mt}}{p_4^{0t} \cdot I^{(m-1)t} \cdot \dfrac{p_1^{mt} + p_2^{mt} + p_3^{mt}}{p_1^{(m-1)t} + p_2^{(m-1)t} + p_3^{(m-1)t}}} \qquad (6.8.7)$$

and similarly for g_5.

A simplified approximate form of the computation is:

$$g_4 \;=\; \frac{p_4^{mt}}{p_4^{0t} \cdot I^{(m-1)t}} \qquad (6.8.8)$$

Comment on applicability: where replacements are infrequent and generally random, the method in effect works in a way similar to that of bridged overlap. But where replacements are more frequent, backcasting has a disadvantage due to its less controlled statistical inference properties.

Furthermore, the underlying assumptions of bridged overlap have a more transparent interpretation, although they can and should be critically questioned on a case-by-case basis. For backcasting, the underlying assumptions appear to be more problematic.

6.8.4 Link-to-show-no-price-change (a C method)

The method of *link-to-show-no-price-change* means that the value of the quality change is assessed as the change in price since the preceding period.

Aliases: link-to-show-no-price-change is also known as automatic linking, Price change taken as quality change, or price difference equals quality difference.

Basic usage: link-to-show-no-price-change is generally banned by Article 5(5) of Regulation No 1749/96 and may not be used unless it can be justified as appropriate for a specific application.

Underlying assumptions: the applicability of the method rests on the assumption that true price changes in conjunction with quality changes either do not exist or are negligible, and that the difference in consumer value (i.e. quality) between the replacement and replaced product offers is equal to the full difference in price. The assumption is logically circular, as it is based on a prejudice about the outcome of the measurement to be made. There are good reasons for the general ban on link-to-show-no-price-change as a method, as this method would risk hiding some actual price changes.

Examples of use: generally not allowed unless it can be justified as an appropriate estimate. The option of justifying the use is probably not very applicable in practice, as a justification would generally have to be based on some other method for quality adjustment, which should then be used instead.

Comment on applicability: generally not applicable.

7

The treatment of special cases

This chapter deals with a number of different types of product in which the usual methods of index construction have to be specially interpreted because of their unusual characteristics.

The chapter is divided into six parts, each addressing a specific problem area. They are:

7.1   Seasonal products

7.2   Cross-border internet purchases

7.3   Service charges proportional to transaction values

7.4   Tariffs

7.5   Zero prices

7.6   Bundles.

7.1   Seasonal products

This section deals with products which are generally unavailable or scarcely available during particular times of the year, following a typical annual cycle. Climate, social traditions and institutional arrangements are the main causes of seasonal unavailability. Such products are known as *seasonal products*. The importance of the treatment of seasonal products in consumer price indices has long been recognised by price statisticians. In 2009 agreement was reached in the form of a Regulation No 330/2009 laying down rules on the treatment of seasonal products in the HICP. (See Section 7.1.2)

Note that products which exhibit a seasonal pattern of sales, but are nevertheless available throughout the year, are not included in the above definition of *seasonal products*. The ILO CPI Manual names these types of products as *weakly seasonal*, while products which are absent (or almost absent) from the market for certain periods of the year are termed *strongly seasonal*. The HICP does not treat weakly seasonal products as being seasonal, and they are thus not subject to the rules laid down in Regulation No 330/2009.

It should also be noted that the HICP is not subject to any form of seasonal adjustment, which aims to smooth out index numbers, taking account of periods in the year when prices may tend to be higher or lower than average.

The growing importance of imports and new methods of domestic production, such as the growing of fruit in glasshouses and polytunnels, tends to extend the seasonal availability of some products, and indeed can result in typical summer products such as strawberries being available all year round, though the prices, quality and quantities sold may be very different from those applicable during the normal domestic season. This may affect both the identification of truly seasonal products and the choice of measurement approach adopted. Moreover, a particular EU country may have decided that the imported version of a particular product differs so much from the domestic product, both in quality and price, that they are treated as distinct products, perhaps with their own different seasons. However, if imports are perceived by consumers to be equivalent in quality to home-produced products, and prices can be observed in every month, it is not necessary to treat such products as seasonal.

Regulation No 330/2009 does not distinguish between seasonal goods and seasonal services: seasonal products cover both of these categories. It may be pointed out, however, that there are certain differences in the treatment of goods and services as regards the timing of the recording of acquisition (i.e. the time of entering the price into the index). Paragraph 3.118 of ESA (2010) states that:

> *'Goods and services are acquired by institutional units when they become the new owners of the goods and when the delivery of services to them is completed'.*

In the case of services, the time of acquisition is considered to be, for the purposes of the HICP, the month in which actual consumption of the service can begin. Thus, for the purchase of a season ticket whose starting date is several months from the date of purchase, the transaction is assigned to the month when the purchaser can start to use the season ticket. This principle applies equally to seasonal and non-seasonal services.

Seasonality is one of the main causes of missing price observations. In practical terms, the problem with seasonal products is this: if a product has disappeared from the market and is expected to return within a short time, its

price can be estimated (or, perhaps more precisely, *imputed*) for the period when it is missing. If, on the other hand, a product offer has disappeared from the outlet(s) in question and is *not* expected to return, it is replaced in the sample by an alternative product. With seasonal products, neither of these two conditions applies; it is known that a seasonal product will return to the market after a fairly predictable period. There is no point in replacing it with another product, but equally its price should not be carried forward unchanged for several months.

This problem is solved by reference to the aim of the HICP: the measurement of inflation. If, for example, prices generally are rising fast and a seasonal product disappears from the market, then temporarily treating its price as unchanged would have the effect of temporarily reducing the measured rate of inflation. This is unlikely to correspond to consumer and user perceptions of inflation. The solution is therefore to find a method which adequately imputes the missing prices during the out-of-season periods. Several methods are available, and they are described in this chapter. None of them can be regarded as ideal, but they are generally seen as a considerable improvement on disregarding seasonality entirely.

It should also be noted that while extracts from Regulation No 330/2009 refer to COICOP, the remainder of the text in this chapter refers instead to ECOICOP, which has in practice replaced COICOP in the context of the HICP (see Chapter 2).

In the sections following 7.1.4, details are provided regarding the methods to be used in the compilation of price indices for seasonal products according to the current HICP legislation. The topics covered are:

7.1.5.1   General approaches to computing price indices for seasonal products

7.1.5.2   Strict annual weights index method: basic approach

7.1.5.3   Strict annual weights index method: counter-seasonal and all-seasonal estimation

7.1.5.4   Class-confined seasonal weights index: methods for estimating weights

7.1.5.5   Example of method for determining monthly weights in a class-confined seasonal weights index

7.1.5.6   Price-updating of weights

7.1.6   Data sources used for estimation in class-confined seasonal weights index

7.1.7   The interpretation of monthly and annual inflation rates.

7.1.2   Legal framework, definitions and terminology

Commission Regulation (EC) No 330/2009 of 22 April 2009 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of seasonal products in the Harmonised Indices of Consumer prices [44] was amplified by an Information Note published in the Compendium of HICP Reference Documents (2013), which took account of Member States' experiences with applying the above Regulation. This section is based on the current rules and recommendations in force for the HICP.

Article 2 of Regulation No 330/2009 gives the following definitions relating to seasonal products:

'For the purpose of this Regulation, the following definitions shall apply:

1. 'seasonal products' means those goods and services that are not available for purchase, or purchased in small or negligible volumes, for certain periods in a typical annual cyclical pattern. The in-season period is meant to cover at least one month;

2. 'subdivision of COICOP/HICP' means COICOP/HICP class in the case of goods and services in a COICOP/HICP class, and COICOP/HICP group for groups that are not subdivided into classes according to the harmonised COICOP/ HICP classification as laid down in Regulation 1749/1999 of 23 July 1999 amending Regulation (EC) No 2214/96, concerning the sub-indices of the harmonised indices of consumer prices (9);

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[44]   OJ L 103, 23.4.2009. p. 6.

*3. '*counter-seasonal estimation' means the estimation of a price for a product-offer of a product that is out-of-season so that:*

– *in the first month of the out-of-season period, the estimated price is equal to a typical price observed in the previous in-season period, and*

– *from the second month, the estimated price is equal to the estimated price for the preceding month, adjusted by the change in observed prices on average over all-seasonal products that are in-season in the same subdivision of COICOP/HICP;*

4. 'all-seasonal estimation' means the estimation of a price for a product-offer of a product that is out-of-season so that:

– *in the first month of the out-of-season period, the estimated price is equal to a typical price observed in the previous in-season period, and*

– *from the second month, the estimated price is equal to the estimated price for the preceding month, adjusted by the change in observed prices on average over all available products in the same subdivision of COICOP/HICP;*

5. 'strict annual weights index' means a price index using weightings that do not differ between months within the same year at all levels of index calculation;

6. 'class-confined seasonal weights index' means a price index using weightings that within the same year:

– *do not differ between months for any COICOP/HICP subdivision taken as a whole,*

– *do not differ between months for products within any COICOP/HICP subdivision that does not contain any seasonal product,*

– *within the in-season period do not differ between months for products within any COICOP/HICP subdivision that contains seasonal products, except to the extent that it is necessary to allow for month-on-month changes in the composition of the basket.'*

Articles 3-5 of Regulation No 330/2009 lay down the following rules on the treatment of seasonal products:

'Article 3
Scope

1. The minimum standards shall apply to seasonal products within the following COICOP/HICP classes and groups:

> *01.1.3 Fish*

> *01.1.6 Fruit*

> *01.1.7 Vegetables*

> *03.1 Clothing*

> *03.2 Footwear*

2. Where appropriate, the minimum standards shall serve as guidance also concerning seasonal products within COICOP/HICP classes and groups other than those listed in the first paragraph.

Article 4
Minimum standards

1. In any given month, seasonal products shall be deemed to be either in-season or out-of-season. In-season periods may vary from one year to another.

2. An HICP sub-index at elementary product group level shall be a strict annual weights index or a class-confined seasonal weights index.

3. For an HICP that is a strict annual weights index, estimated prices shall be used for seasonal products that are out-of-season, in accordance with Article 6(1)(b) of Regulation (EC) No 1749/96.

4. For an HICP that is a strict annual weights index, an estimated price for a product-offer of a seasonal product that is out-of-season shall be defined either by counter-seasonal estimation or by all-seasonal estimation. Hereby counter-seasonal estimation shall be preferred where the Member State deems it feasible with respect to the availability of observed prices, as may be likely for clothing and footwear. Where counter-seasonal estimation is not deemed feasible, all-seasonal estimation shall be used.

5. For an HICP that is a class-confined seasonal weights index, a seasonal product that is out-of-season shall have a weight of zero.

6. For an HICP that is a strict annual weights index, estimations may also be performed at a more detailed level than the subdivision of COICOP/HICP, such as for strata if a stratified sample is being used. For an HICP that is a class-confined seasonal weights index, seasonal weights may also be established at a more detailed level.

7. Changes in prices of seasonal products for which the share of the total consumption expenditure, covered by the HICP, during a typical in-season period is likely to be at least two parts per thousand shall be reflected in the HICP.

8. The weights for seasonal products shall be compiled and updated as necessary in accordance with Articles 2 and 3 of Regulation (EC) No 2454/97. The indices used for the annual price updating of weights, where the index computation so requires, shall refer to the average prices of the month used for updating.

Article 5
Comparability

HICPs constructed following standards other than those required in Article 4 of this Regulation shall be deemed comparable if they result in indices which do not differ systematically from an index compiled following the provisions of this Regulation by more than:

(a) one tenth of one percentage point on average over one year against the previous year for the all-items HICP;

(b) three, four or five tenths of a percentage point on average over one year against the previous year for any COICOP/HICP division, group or class;

(c) one tenth of one percentage point on average for an individual month against the previous month of the all-items HICP.'

The rules on the treatment of seasonal products deal exclusively with products that are *not* available for purchase all year round, and for which no prices can be observed in certain periods, and where consumers may purchase other products from the same ECOICOP category as an alternative. In fact, expenditure shares of most products vary from month to month. Ice-cream, for example, is purchased more during the summer months, but since it is available all year round and prices are readily available, it is not considered as a seasonal product. The particular characteristic of seasonal products is that they are not normally available for purchase during certain months, or that the quantities purchased in certain months are so small as to be considered negligible. As a result, prices cannot be or are not observed during these months.

The HICP measures monthly price developments in a basket that represents the expenditure over a 12-month weight reference period. In principle, each monthly price change is measured using an unchanged basket. Regulation No 330/2009 therefore does not aim to give rules regarding varying expenditure shares of products such as ice-cream during the year. Rather, it sets out rules on how to deal with variations in the availability of products.

Regulation No 330/2009 states that there should be some kind of annual cyclical pattern to the periods when a product is not available. This means that if a product is unavailable in a given month for some exceptional reason, its unavailability does not make it a seasonal product. If, for example, no bus tickets are sold in a given month because of a long bus drivers' strike, bus tickets should be treated not as seasonal products, but as products that are temporarily missing.

7.1.3   The definition of in-season and out-of-season periods

In-season and out-of-season periods usually fall into a fairly stable pattern, which for year *t* must be determined before the weighting scheme is established, i.e. by December of year *t*–1 at the latest, reflecting the HICP rules on weight reference periods (see Chapter 3).

The out-of-season period of a seasonal product includes the months in which no prices are observed or used in the index compilation for that product because it is not available. The in-season period in year *t* should *not* be adjusted as a result of observations on product supply during the current year *t*.

However, Regulation No 330/2009 notes that the in-season period may vary to some extent from one year to another. If, for example, it is observed during the current year that the annual availability of a product is changing, the division into in-season and out-of-season periods can be adjusted for use in the *following* year. This may happen exceptionally if, for example, because of climate change or new cultivation methods, some seasonal fruits become available earlier in the year, or if the period of availability is extended by rising consumption of imported products.

As the in-season period must be defined prior to the current index year, there is always a possibility that prices may, exceptionally, be unavailable in the first or the last month of a season. In such cases prices must be estimated, regardless of whether a strict annual weights index method or a class-confined seasonal weights index method is being used. These methods are described in Section 7.1.5. A new product may also be identified as seasonal, but this is not likely to be established until its availability has been observed over time.

7.1.4　Scope of seasonal products

Article 3 of Regulation No 330/2009 sets out the range of product categories to which the rules in the Regulation must be applied. They comprise certain fresh foods and clothing: Fish (ECOICOP 01.1.3); Fruit (01.1.6); Vegetables (01.1.7); Clothing (03.1); and Footwear (03.2). Many other products exist which exhibit seasonality, such as package holidays, meat, Christmas-related products and winter and summer sports equipment. Applying the rules in the Regulation to such products is also encouraged, but is not mandatory. In other words, where deemed appropriate, the rules should preferably be applied to seasonal products in other ECOICOP classes or groups, such as those mentioned above (see Sections 12.5 and 12.7). There are no explicit rules on whether or not to treat a particular product as seasonal. Clearly, there must be some seasonal pattern. Testing with real data should reveal whether or not treating a product as seasonal has a significant effect on the relevant published sub-index or, indeed, on the all-items HICP.

In addition, Article 5 of Regulation No 330/2009 explains that if methods different from those described in the Regulation are used, Member States must be able to show that applying them does not result in sub-indices that differ systematically from an index compiled in accordance with the Regulation.

7.1.5　Compilation techniques for seasonal products

7.1.5.1　General approaches to computing price indices for seasonal products

The HICP is defined as a Laspeyres-type index, which can be computed using monthly elementary aggregate indices and weights representing the expenditure pattern in the weights reference period (see Chapter 8).

In those months when prices of seasonal products cannot be observed, this type of index cannot be computed. Two alternative solutions to this problem are set out in Regulation No 330/2009:

1. Treat seasonal products as far as possible in the same way as non-seasonal ones. To do this, estimate out-of-season prices by following changes in the prices of the most similar products in the same ECOICOP sub-class, class or group. This method produces an index called a strict annual weights index. (Other sources often refer to it as a fixed weights index). The name reflects the fact that since prices (either actual or estimated) are used throughout the year, the normal fixed annual weight method used for non-seasonal products can be used.

2. Acknowledge the reality that no prices can be observed in out-of-season periods, and that weights for those months are set to zero. During the in-season months, the weights vary according to the varying consumption pattern. The resulting index is known as a class-confined seasonal weights index (referred to in some sources as the variable weights method). The use of the term 'seasonal weights' refers to the fact that the weights are based on estimates of actual monthly availability. The term 'class-confined' reflects the fact that the choice of products used to proxy the missing seasonal products is normally confined to the same sub-class, class (or group) to which the seasonal product belongs.

The strict annual weights index has the advantage of being theoretically consistent with the treatment of other product categories in the HICP. A disadvantage is its dependence on estimations (or, more correctly, imputations).

Cherries might be available on the market in the summer months only, but the strict annual weights index approach assumes that they are available throughout the year. This necessarily leads to estimation and to the introduction of *artificial* price quotes in the index, based on goods that are likely to be of limited comparability.

The class-confined seasonal weights index has the advantage that it allows consumption patterns to change, reflecting market availability, while minimising the use of estimation techniques. A disadvantage is that as the weights reflect only the pattern of consumption in the base year (weights reference period), atypical seasonal fluctuations in both the time the season starts or ends and unusual prices at the beginning or end of the season can affect the measured rate of inflation. For example, if unusual weather conditions delay the arrival of peaches on the market, then some sort of estimation would have to be considered in the months in which peaches are unavailable. A further disadvantage in terms of the transparency of the class-confined seasonal weights index is that month-to-month price changes reflect not only changes in price relatives but also changes in weights. That makes them less straightforward to interpret than month-to-month figures produced under the strict annual weights index approach [45].

No matter which of the two approaches is used, it has to be borne in mind that no perfect solution exists; the advantages and disadvantages of each method should be recognised and, if possible, measured or assessed before implementation. The results of the two methods should be approximately the same, and this should be borne in mind when deciding which method to use.

Table 7.1.1 summarises the main pros and cons of the two approaches.

Table 7.1.1 Advantages and disadvantages of strict annual weights index and class-confined seasonal weights index for treatment of seasonal products in price indices

Approach chosen	Advantages	Disadvantages
(a) Strict annual weights index	Theoretical consistency with the Laspeyres-type indices. All indices build on the same fixed weights principle.	Choice of estimation method. Annual fixed weights may not be representative of monthly availability.
(b) Class-confined seasonal weights index	Introduction of changing seasonal availability patterns. Minimisation of price estimation practices.	Lack of consistency with Laspeyres-type indices (because of variable weights). Month-to-month price change reflects not only changes in price relatives, but also changes in availability. Impact on inflation in cases of unusually late availability or early unavailability of some seasonal products.

7.1.5.2 Strict annual weights index method: basic approach

Following Regulation No 330/2009, under the strict annual weights index approach, out-of-season prices of seasonal products must be:

1. replaced in the first month of the out-of-season period by a *typical in-season price*, then

2. estimated from the second month on the basis of changes in the prices of other products in the same ECOICOP sub-class, class or group.

The Regulation does not prescribe what a *typical* in-season price is. However, the official Eurostat Recommendations [46] state:

> *'This typical price is meant to be different from exceptional prices like end-of-season sales prices. It may be, for example, the average in the previous season or the regular price observed before the sales period. This rule aims to prevent exceptional prices having an impact on the indices during the full out-of-season period.'*

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[45] The latter is to say that the ratio of two consecutive index numbers built upon a variable weights framework does not strictly respect the proportionality axiom of a price index. This axiom says that if all price reference prices are multiplied by a positive number k, the result will be a new price index which is *k* times the price reference period index. This property is often regarded as natural, since it makes an index analogous to a price relative (price ratio). But the argument is not fully conclusive.

[46] Compendium of HICP Reference Documents; Annex 1 to Section 2 (Recommendations), paragraph 2.5 — Treatment of seasonal products (Implementation Review, updated in January 2013).

It is clearly important that the initial out-of-season estimates are not biased as a result of using atypical prices, which are often observed for many seasonal products in the last month of their availability. This is particularly true for seasonal clothing and footwear, where at the end of each season unsold products are often sold at heavily discounted prices. To avoid any downward bias in the index, the *typical price* used in the first month of unavailability could be the modal price, or the mean in-season price. If end-of-season sales are held, the last observed in-season price should not be used when establishing the *typical price*.

See also Section 12.5 on the treatment of flights and package holidays, and Section 12.7 on clothing and footwear. Both of these sectors present particular problems in estimating typical prices. Section 7.1.5.3 below discusses the treatment of fresh products such as fruit; the same treatment applies to other fresh seasonal products, including vegetables and fish.

Under this approach, when a new product is first included in the sample, there must be a price available in December of t–1. If the product is known to be out of season in December, then a typical price from the in-season period in the previous year should be used for the December t–1 index. Prices for the index for January onwards for year t should then be imputed as described above until the product becomes available (i.e. until it is in season). Under this approach, the coverage of sample products needs to be reviewed well before the annual resample, to collect any prices required to estimate a typical price for the first December index.

Note that this method is not designed for ECOICOP sub-classes, classes or groups in which all products have the same seasonal pattern, resulting in months when expenditure on the entire class or group falls to a very low level. Examples include heating energy and heating gas. The general rules for the treatment of missing prices and replacements apply in such cases.

It is also worth noting that Regulation No 330/2009 lays down no specific rules on product definitions. Some countries may define a summer coat and a winter coat as two distinct seasonal products, whereas other countries may define an all-year product *coat* with a looser description covering both winter coats and summer coats. This is permissible, as it may well reflect different climatic conditions (though there may be quality-adjustment issues).

7.1.5.3 Strict annual weights index method: counter-seasonal and all-seasonal estimation

Article 4 of Regulation No 330/2009 allows for two alternative methods for estimating the prices of out-of-season products when using the strict annual weights index method: *counter-seasonal estimation* and *all-seasonal estimation*. The Regulation makes it clear that counter-seasonal estimation is preferable unless circumstances make it impossible or undesirable.

Counter-seasonal estimation

This method involves estimating the index for out-of-season products using only the prices of *seasonal products* in the ECOICOP sub-class, class or group. An ECOICOP sub-class, class or group containing seasonal products may consist entirely of such products — though their out-of-season and in-season periods may not necessarily be identical. A common example is fresh fruit. Quite often, however, the ECOICOP sub-class, class or group also includes non-seasonal products for which prices can be observed all year round. This may be the case for clothing, some of which is available all year round (e.g. jeans, socks, and underwear), while shorts may be available only in spring and summer.

The reasoning underlying counter-seasonal estimation is that both in-season and out-of-season products serve similar purposes, although in different conditions. In contrast, non-seasonal products within the same ECOICOP sub-class, class or group may have different uses. For instance, formal dinner suits are available all year round in order to comply with a dress code, so they cannot be replaced either by an informal winter suit or a lightweight suit, regardless of weather conditions. On the other hand, warm and lightweight clothes have the same purpose of protecting the body and are substitutable according to the temperature conditions.

Counter-seasonal estimation may not always be feasible. For example, certain fruits in some countries may be available either all year round or only in the summer. In such cases the price for summer fruits in the out-of-season period cannot be estimated using only *winter fruits* that are not available. In this case, all-seasonal estimation should be used. However, the growth in imports means that some fruits, such as apples, bananas and oranges, may be available all year round, but a judgement needs to be made as to whether enough prices are available for the counter-seasonal approach (the method preferred in the Regulation) to be used. If not, all-seasonal estimation may be used.

All-seasonal estimation

In the all-seasonal estimation method, the index for out-of-season products is estimated using the prices of *all available products* in the ECOICOP sub-class, class or group. For example, the prices of fresh summer fruits during the out-of-season winter months are estimated using data for all fruits available in winter (including tinned, dried and frozen fruit.)

All-seasonal estimation implicitly assumes that in-season, out-of-season and all-season products are near-substitutes from the consumer's point of view. All types of fruit provide nutrition throughout the year. Seasonal availability and seasonally changing tastes give rise to changing consumer purchases.

Choice of method

Counter-seasonal estimation (the preferred method in Regulation No 330/2009) is recommended when the year has two distinct seasons, e.g. where summer products replace winter products and vice versa, and where in each month of the year there are sufficient seasonal products available on which to base the estimation procedure, e.g. clothing.

All-seasonal estimation should be restricted to situations where the seasonal pattern is less clearly defined and where the number of seasonal products available is small for parts of the year, e.g. some fruits.

7.1.5.4   Class-confined seasonal weights index: methods for estimating weights

For the HICP, annual, not monthly, weights are the target. As such, within a year for the class-confined seasonal weights approach, the in-season weights should remain fixed if the composition of the seasonal basket does not change from one month to the next.

In the class-confined seasonal weights index approach, monthly weights need to be estimated. This approach involves assigning zero weights to out-of-season products. During the in-season period, the weights are allowed to vary in line with fluctuations in the expected monthly availability of products, but only to the extent necessary to reflect changes in the composition of the basket. Aggregate weights for ECOICOP sub-classes, classes or groups are fixed for the whole year, just as for non-seasonal products. This means that weights must be constant (i.e. fixed) down to the lowest level of ECOICOP published (by Eurostat), ideally the 5-digit sub-class level (if possible).

Using the class-confined seasonal weights index method, variations in weights may serve two purposes. Firstly, they allow for out-of-season periods in which products are not available and prices cannot be measured directly. Secondly, they allow for variations in the composition of the basket during the year.

This method contrasts with the standard HICP method for *non-seasonal products*, where variations in weights within the year are not allowed. There are two reasons for this:

1. A price index with seasonal weights has the disadvantage that the index may change between months not only because prices have changed, but also because the distribution of weights has changed.

2. The HICP is in general an index measuring, on a monthly basis, developments in the price of a basket of goods and services consumed over a 12-month period. So for products that are not seasonal, seasonal fluctuations in availability (and hence consumption) are irrelevant.

Fluctuations in the weights can be minimised by using the following procedure:

1. Determine the yearly average weight per product within the ECOICOP sub-class, class or group of seasonal products.

2. The out-of-season months should be clearly defined.

3. The monthly weights of the in-season period should then be determined, ensuring that:

    •   monthly weights of ECOICOP sub-classes, classes or groups are equal each month

    •   weights are zero if and only if the product in question is expected to be out of season

    •   the average product weight during the year represents the product's annual weight

    •   the weights of seasonal products do not vary during periods when the set of in-season products is constant.

In practice, to calculate monthly weights fulfilling these requirements, the following method is recommended. A worked example is given in Table 7.1.2.

Section A shows the annual expenditure on each product. Section B shows each month's proportional shares of the products' annual volumes. These two sections are given data. Sections C and D are based on these data. Section C combines data from sections A and B to give estimated monthly expenditures on each product, plus the class total. Section D calculates the weights of each product for each month, using data from Section C. The formulas used are shown at the foot of the table.

This method ensures that the weights of seasonal products are treated like other products as far as possible, and that the impact of changing weights on the monthly change in the HICP is reduced to a minimum. The method is explained in more detail in the following section.

7.1.5.5 Example of method for determining monthly weights in a class-confined seasonal weights index

Three products, A, B and C are considered.

Product A is a winter product, in season from September to April. Products B and C are summer products: B is in season from April to August, while C is in season only from May to August.

There are no data on monthly expenditures — only the annual totals (Rows 1-4 in Table 7.1.2). However, it is necessary to estimate the monthly shares. This is shown in rows 5-7. These estimates are based on rough approximations by the Member State or trade or other sources. The figure of 12.5 % for product A in row 5 indicates that 12.5 % of the annual sales of A (€96 m) fall in each of the 8 months from September to April. In row 6 we can see that 20 % of the annual sales of B (€60 m) are in April, with a further 20 % falling in each of the 4 months from May to August. Row 7 shows that 25 % of the annual sales of C (€72) fall in each of the 4 months from May to August. This is a simple example, and in practice estimated figures may vary month by month.

Next, using these estimated proportions, we can estimate the sales values of each product in each in-season month. These are shown in rows 8 to 10. For example, the monthly sales of product A are estimated at €12 m, 12.5 % of the annual total of €96 m. The other figures are calculated in the same way. Row 11 shows the total monthly sales of all three products, totalling the known figure of €228 m.

The final step is shown in rows 12-14. These are the monthly class weights for each of the three product groups. For example, from September to March the only product in season is A, so it accounts for 100 % of the weight. Between May and August, however, A has no sales and hence a weight of zero. Product B has sales of €12 m out of a monthly class total of €30 m, a proportion of 40 %, while product B has sales of €18 m from the same class total of €30 m, a proportion of 60 %. Row 15 shows, as a check, that the class weights add up to 100 % each month.

Table 7.1.2: Class-confined seasonal weights index, an example of a method for determining monthly weights

A		Annual expenditures (€m)												
1	Product A	96												
2	Product B	60												
3	Product C	72												
4	Class Total	228												
B		Estimated monthly availability estimates (shares of annual total expenditures) (%)												
		J	F	M	A	M	J	J	A	S	O	N	D	Year
5	Product A	12.5	12.5	12.5	12.5	0	0	0	0	12.5	12.5	12.5	12.5	100
6	Product B	0	0	0	20	20	20	20	20	0	0	0	0	100
7	Product C	0	0	0	0	25	25	25	25	0	0	0	0	100
C		Estimated monthly expenditures (€m)												
8	Product A	12	12	12	12	0	0	0	0	12	12	12	12	96
9	Product B	0	0	0	12	12	12	12	12	0	0	0	0	60
10	Product C	0	0	0	0	18	18	18	18	0	0	0	0	72
11	Class Total	12	12	12	24	30	30	30	30	12	12	12	12	228
D		Relative class weights (%)												
12	Product A	100	100	100	50	0	0	0	0	100	100	100	100	
13	Product B	0	0	0	50	40	40	40	40	0	0	0	0	
14	Product C	0	0	0	0	60	60	60	60	0	0	0	0	
15	Class Total	100	100	100	100	100	100	100	100	100	100	100	100	
KEY:														
Rows 1-3, 5-7	Source data													
Row 8	Row 1 * Row 5 /100													
Row 9	Row 2 * Row 6/100													
Row 10	Row 3 * Row 7/100													
Row 12	Row 8 / Row 11*100													
Row 13	Row 9 / Row 11 *100													
Row 14	Row 10 / Row 11*100													

The set of weights obtained in this way is not unique in fulfilling the requirements mentioned in Section 7.1.5.4. Alternative algorithms — or, indeed, estimates of monthly expenditures — may reduce the variation in the monthly weights, if this is considered desirable. However, standard approaches of iterative proportional fitting, sometimes mentioned in the literature, are not directly applicable to the HICP, as zero values then have to be handled.

7.1.5.6   Price-updating of weights

At each level of publication, the HICP is compiled as a yearly chain-linked index, as described in Chapter 8. The weights used for the annual chain links of year t have to be price-updated to reflect expenditures expressed in the price level of December of year (t–1), using the procedure described in Chapter 3. As regards seasonal products, special consideration is needed for products which are out of season in December. The general principle is that annual weights should always be price-updated to the price reference period, that is, the month in the denominator of the price relatives. This is needed to yield a Laspeyres-type index as required, which is as true for seasonal products as for other products. Thus, weights usually have to be price-updated to December of the preceding year.

However, the situation is special for a summer season expenditure category where the season ends before December. Here, the price-updating procedure depends on whether the fixed weights approach or the class-confined seasonal weights approach is used (as defined in Section 7.1.5.65):

- In the strict annual weights index approach, price-updating is made to the imputed December price level.

- In the class-confined seasonal weights index approach, price-updating is made to the observed price level of the last in-season month, e.g. August, instead of December.

Again, this gives the correct Laspeyres-type index.

As mentioned in Chapter 3, price-updating is mandatory for weights of ECOICOP categories, and optional for the weights of aggregates at lower levels where weighting data may or may not be available. Where price-updating for seasonal products at lower-level aggregates is used, this should be done following the same procedures as described above.

For example, consider a summer-season product category with an annual expenditure of €200 m, where the class-confined seasonal weights index weights approach is used. Suppose that the HICP sub-index is 105.22 for the last in-season month of the preceding year (t–1) and 101.57 is the mean value of the index over the weighting reference period. The price-updated annual weighting expenditure is then calculated as:

$200 \times 105.22 / 101.57 = €207.19$ m.

The monthly weights in the class-confined seasonal weights index approach are determined from the price-updated annual expenditures as described in Section 7.1.5.4.

7.1.6 Data sources used for estimation in a class-confined seasonal weights index

For non-seasonal products in the HICP the weights are fixed annually, based on National Accounts, household budget survey data and other sources, (see Chapter 3). It may be necessary to use additional data sources to estimate monthly weights required for the treatment of seasonal products. For seasonal products in the food category, a food survey may provide the necessary data. Trade or retail sources, such as information from supermarket chains (which may already be used for scanner data) may also provide a source.

In the strict annual weights index, the monthly changes in the index for out-of-season products are estimated from changes in the index for comparable products. Regulation No 330/2009 states that these comparable products should be from the same sub-division, i.e. ECOICOP class (4-digit), or group (3-digit), or from a more detailed level. This may be a further detail of ECOICOP sub-class (5-digit) or it may be data from a stratum within the ECOICOP sub-class, class or group, if a stratification of the observations is being used.

Higher-level aggregates, e.g. ECOICOP divisions (2-digit level), should not be used for estimation purposes. The reasons for this are:

- Inflation rates of higher-level aggregates are likely to be influenced to a large extent by factors that are not relevant to the seasonal products concerned.

- Using products from the same ECOICOP class or group improves comparability with class-confined seasonal weights indices.

- If all Member States that are using a strict annual weights index use comparable estimates, this will tend to improve the comparability of the all-items HICP.

7.1.7 The interpretation of monthly and annual inflation rates

a) Monthly inflation rates (m/(m-1))

Interpreting monthly inflation rates for seasonal products may be difficult for both the strict annual weights index and class-confined seasonal weights index indices.

In the strict annual weights index, neither the monthly rate in the first out-of-season month nor that in the first month of the new season depends solely on observed price changes in the latter month, because one or other of the price values is zero.

In the class-confined seasonal weights index, the monthly rate is determined not only by price changes in the observed month, but also by changes in the weights distribution.

When using the class-confined seasonal weights index method, the non-zero weights for the in-season products are on average higher than the corresponding product weights in the strict annual weights index. This implies that a seasonal product has more impact on inflation during its in-season period, but, on the other hand, in the strict annual weights index the product may additionally influence inflation via an out-of-season product, where its price is estimated. Over a twelve-month period, these differences may more or less cancel out, but there is no guarantee of this.

b) Annual inflation rates ($m/(m$-12))

When using a strict annual weights index, annual inflation rates for seasonal products can be calculated entirely from observed prices during in-season periods. They will, however, be calculated entirely from estimated prices during out-of-season periods. Such estimates must have some justifiable meaning.

This is achieved by estimating the index in the first out-of-season month to the average or typical price for the just-ended in-season. Then the year-on-year inflation in this first out-of-season month equals the average of the year-on-year inflation results that were measured during the in-season period, or the difference between the typical prices in the two seasons compared. Otherwise the last measured in-season prices may have too much impact on the out-of-season inflation estimates.

For the remaining out-of-season months, year-on-year inflation will follow the trend of inflation measured by the prices of in-season products.

In the case of the class-confined seasonal weights index, the annual rates of change for ECOICOP sub-classes, classes or groups with seasonal products are determined solely by comparing the observed prices of the in-season products.

7.2 Cross-border internet purchases

7.2.1 Introduction

The world economy has changed significantly since the HICP was first launched in the mid-1990s, driven by the twin forces of globalisation and the internet (e-commerce). The latter has revolutionised the way in which consumers make many of their purchases. In 2014, online purchases accounted for around seven per cent [47] of the value of all purchases in Europe, and the volume of these purchases has been rising fast in recent years. More and more of businesses' turnover comes from e-commerce. Travel tickets and package holidays are nowadays more often purchased online than in high street travel agencies.

Given the increasing importance of internet purchases for EU consumers, this relatively new type of outlet cannot be overlooked in the computation of the HICP. It must be within scope when designing the outlet samples and included in national HICPs, according to their significance. Some categories of goods and services, such as flights, package holidays, books, music (CDs and downloads) and DVDs, are now typically purchased online. Accordingly, internet retailers selling these products at least should be included in HICP samples, according to their significance. Moreover, there are good reasons for specifying online shopping as a new type of outlet, as price changes in internet outlets may differ from those in other outlets. This is easy to demonstrate. Two of the reasons given by consumers for using the internet are price-related. Firstly, internet prices — even including delivery charges — are frequently lower than prices for the same products sold in physical outlets. Moreover, it is often easier for consumers

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[47] Source: Centre for Retail Research.

to compare the prices of different online suppliers than those of physical outlets. In addition, delivery costs for large items may be competitive in comparison with delivery charges for goods ordered from traditional outlets.

The Recommendation on the treatment of cross-border internet purchases borrows from the VAT rules [48] that became effective in January 2015 in all Member States. The new VAT rules take into account that a growing number of products are electronic (e-books, for example), rather than a physical good or service in the traditional sense.

The new VAT rules draw a distinction between goods, digital services and other services. For goods ordered online, the place of delivery determines the VAT rate. Usually this will be the country of residence. For digital services, the VAT rate is determined by the country where the purchaser normally resides. For non-digital services such as flights and package holidays — even if booked online —VAT is determined by the country where the tangible service is provided. Following the new VAT rules, the HICP Recommendation on the treatment of cross-border internet purchases has been developed to ensure harmonisation between all Member States — see Section 7.2.2.

The Recommendations also cover purchases ordered by phone or from mail order catalogues, which are treated in the same way as online purchases because of the similarities between different forms of *remote* purchase — see Section 7.2.4.5.

7.2.2 HICP Recommendation on the treatment of cross-border internet purchases

Although Eurostat recommendations have no formal legal status, the idea is that Member States should abide by them. Eurostat considers them applicable for the purposes of monitoring the quality of individual Member State HICPs.

The Recommendations on the treatment of cross-border internet purchases state the following:

Recommendation 1: Purchase of goods

The expenditure and the prices for goods purchased through the internet shall be recorded in the HICP of the country where the product is delivered.

Recommendation 2: Purchase of services of a tangible nature

The expenditure and the prices for services of a tangible nature purchased through the internet shall be recorded in the HICP of the country where the service is provided.

Recommendation 3: Purchase of digital services

The expenditure and the prices for digital services (communication, broadcasting and electronic services) shall be recorded in the HICP of the country where the consumer usually resides.

Recommendation 4: Extra costs

The price to be recorded should be the full price, including any compulsory additional costs, provided that these costs can be attributed solely to the purchase of the product concerned.

Recommendation 5: Other distance purchases

The expenditure and prices relating to other distance purchases, for example by phone or mail order, shall be treated in the same way as internet purchases with regard to extra costs and for determining the country where expenditure and prices shall be accounted for.

7.2.3 Definitions and terminology

The following definitions have no legal status, but may be regarded as working definitions:

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[48] http://ec.europa.eu/taxation_customs/business/vat/telecommunications-broadcasting-electronic-services_en

Additional costs: any costs charged by an internet supplier over and above the cost of the product itself, such as delivery charges, booking fees and credit or debit card fees.

Digital services: all electronic services (including downloading and streaming of software, music and on-demand TV, social media — Facebook, Instagram and dating sites, etc.), TV and radio broadcasting and telecommunication services.

Domestic concept: defines the scope of the HICP as all household final monetary consumption expenditures on the economic territory, regardless of the nationality or normal residence of the consumer (see Chapter 2).

Electronic services: services supplied online (or through another electronic network, e.g. cable TV, gaming services and services accessed via mobile telephone networks) which, given their nature, are supplied by essentially automated means, involving minimal human intervention and cannot be supplied without information technology. The VAT rules give the following list of electronic services:

- Website supply, web-hosting, distance maintenance of programmes and equipment.

- Supply of software and software updates, e.g. MS Office, security software and photo-editing software.

- Supply of images, text and information and the making available of databases, e.g. e-books, online newspapers and news sites, and other electronic publications.

- Supply of music, films and games, including games of chance and gambling games, and broadcasts of political, cultural, artistic, sporting, scientific and entertainment events, streaming or downloading of films, receiving television programmes online for viewing at the moment chosen by the user and at the user's individual request, on the basis of a catalogue of programmes selected by the media service provider, such as TV or video on demand.

- Supply of distance teaching (automated online distance teaching the supply of which requires limited or no human intervention, such as online training courses).

Tangible services: services linked with immovable property, passenger transport, services involving admission to cultural, artistic, sporting, scientific, educational, entertainment and similar events and restaurant and catering services.

7.2.4 Explanatory text

The domestic concept (see Chapter 2)

The domestic concept determines the geographical coverage of the HICP. It is set out in Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, Articles 2(18), 2(19), 2(20) and 3(3). Article 3(3) states that:

> 'the HICP[…] shall be based on the price changes […] of products included in the household final monetary consumption expenditure'.

Article 2(20), defines household final monetary consumption expenditure (HFMCE) as expenditure incurred by households on the economic territory of the Member State. Article 2(18) stipulates that households must be included irrespective of nationality or residence status.

Treatment of cross-border internet purchases in the HICP

In the case of cross-border internet purchases, there is a need to give the domestic concept underlying the HICP an unambiguous and operational interpretation. The aim is to ensure consistent geographical coverage of the related prices in the HICP across Member States.

The traditional — non-internet — case of households buying goods and services abroad is tourism expenditure. Households are physically outside the economic territory of their country of residence when goods and services are

acquired. Both the seller and the place where the good or service is delivered are in the same country, which is not the purchaser's country of residence, and this is the country which includes both expenditure and prices in its HICP.

Cross-border internet purchases are somewhat more complicated. The internet offers virtually unrestricted access to products, and transactions can be made almost anywhere, via connected devices. A person resident in country X orders/purchases products on a foreign website and they may be delivered to country X or Y, or even to a non-EU country.

Clear rules are needed to determine in which country cross-border internet purchases are to be covered. The rules should take account of the conceptual framework of the HICP. They should be practical and robust; even if that means that some special cases get a somewhat simplified treatment.

Using the *country of delivery* criterion for the geographical allocation of the cross-border internet purchases meets these requirements. It reflects the fact that the full price which the consumer has to pay for a good is known only once the country of delivery is known, because only then can delivery charges and the appropriate VAT rate be determined. In the case of services of a tangible nature, it is the country where the service is provided. Furthermore, the country of delivery or provision of the service is where the consumer and the product or service *come together*, which is in the spirit of the domestic concept.

Hence, the general rule should be:

- For goods purchased online, expenditure and price should be covered by the HICP of the country where they are delivered.

- For services of a tangible nature, it is the country where the service is provided, and for digital services it is the country where the consumer usually resides.

In complex cases, appropriate proxies to the delivery criterion are to be used. See Section 7.2.4.3 for some complex examples.

7.2.4.1   Country of purchase of goods (Recommendation 1)

For *goods* purchased over the internet both the expenditure and the price should be assigned to the HICP of the Member State where the good is delivered. The rationale for this is that the final purchaser price of the good itself and the associated delivery costs can only be determined *after* a delivery address has been supplied. This also corresponds to the country where the VAT is actually paid by purchasers.

The country of delivery is normally the country where the purchaser resides, regardless of the residential status of the seller and/or supplier (which may differ from the country where the purchaser resides). This should include imports of goods delivered directly to the purchaser, which, in the national accounts, are excluded from consumption expenditure on domestic territory.

For example, a British consumer purchases a pair of sunglasses via a link from Amazon.co.uk to an online retailer of sunglasses of an indeterminate location. The order is shipped from Italy and delivered to the UK, where the purchase is subject to UK VAT. Both expenditure and price should be assigned to the UK HICP.

It is important to note that this rule avoids double-counting or non-inclusion of purchases. At the same time, it secures consistency in the treatment of online purchases and follows the scope of the HICP (the domestic concept), as defined in the Framework and Implementing Regulations.

7.2.4.2   Services of a tangible nature booked online (Recommendation 2)

Expenditure on a *tangible service* (services linked with immovable property; passenger transport; services involving admission to cultural, artistic, sporting, scientific, educational, entertainment and similar events; and restaurant and catering services) *booked online*, and its price, should be assigned to the country where consumption first commences. This is because the consumer has to be present at the location of the service provider to start consuming the service, and the place of consumption determines where VAT is paid.

For example, a ticket booked via the internet for an opera at the Royal Opera House in London will include UK VAT, regardless of the residence of the consumer at the time of purchase. Both expenditure and price belong to the UK's HICP. A ticket booked online to watch an opera streamed live from the Royal Opera House in London to a cinema in Luxembourg will include Luxembourg VAT. Both expenditure and price belong to the Luxembourg HICP. In both examples, the country where the service is first supplied equates to the place where VAT is levied, which in turn determines the country to whose HICP expenditure and prices are assigned.

Recommendation 2 is particularly relevant to airfares, package holidays and holiday accommodation booked via the internet (see Section 12.5).

For all services (tangible and digital), including online purchases, Regulation No 2601/2000 regarding the timing of entering purchase prices stipulates that purchaser prices must be recorded in the HICP in the month in which the service *can first commence*.

7.2.4.3   Digital services (Recommendation 3)

Digital services are supplied over the internet (or through another electronic or mobile telephone network) and the nature of which renders their supply essentially automated and involves minimal human intervention, and cannot be delivered without information technology. Digital services also include the costs of installing routers and other service-related equipment. The availability of a helpdesk does not change the fact that all these services are essentially digital.

All digital services are electronic services. This includes all broadcasting and telecommunication services. Section 7.2.3 and Annex 1 of the VAT rules regarding broadcasting and telecommunication services define electronic services and provide examples.

Under the 2015 VAT rules, all digital services are taxed according to the residence of the consumer and not the residence of the supplier [49], as it is the consumer's country of residence that determines the VAT rate. For example, an e-book downloaded by a Luxembourg resident from Amazon.uk is subject to the Luxembourg VAT rate, and both expenditure and price are assigned to Luxembourg's HICP.

Under the 2015 VAT rules, it is the principle of residence of the consumer rather than the residence of the supplier, or the country in which the service was accessed, which determines where VAT is levied. This includes *all* telecommunication, broadcasting and electronic services, not just those concerning downloading and streaming. It clearly makes sense for telecommunication and broadcasting services to be covered by these rules because the relevant service providers need not be located in the country of the consumer's residence, whereas the service is supplied primarily in the country of residence. Examples include Skype, on-demand movies and satellite television.

In the case of online purchases, the rules determining the country of residence have been laid down in such a way that the overwhelming majority of payments, many of which involve small sums of money, can be handled by automated systems. Generally, the consumer's account settings (e.g. within an iTunes account) and the location information automatically provided by the internet connection (IP address) are sufficient to determine the country of residence.

The VAT rules allow suppliers and retailers to make a number of assumptions to simplify the application of the rules:

- If a digital service (telecommunications being the foremost example) requires physical presence at a particular location to access the internet, e.g. a Wi-Fi hot spot, an internet café, a restaurant or hotel Wi-Fi network, or a telephone kiosk, the VAT for using such services is payable in the Member State where those places are located.

- If the service is bought via a mobile operator's network using a device such as a smartphone or tablet, expenditure and price are assigned in accordance with the SIM card country code. For example, if a French resident uses a French SIM card to buy an e-book while on holiday in Germany, French VAT applies.

- If the service is supplied through a decoder or a telephone landline, the location of the landline or decoder determines the VAT rate.

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[49]   Before 2015, it was the service provider's location that determined the rate of VAT levied on the purchase.

In these cases it is clear where the service is provided. If none of the three assumptions given above apply, the retailer needs to keep two pieces of non-contradictory information as evidence for the location and residence of the customer at the time of purchase. This evidence includes:

- the billing address of the customer (normally country of residence),

- the Internet Protocol (IP) address of the device used by the customer (this address can be linked to a country),

- the customer's bank details (the IBAN code contains a country identifier, normally that of the country of residence),

- the country code of the SIM card used by the customer (again, the SIM card code includes a country code),

- the location of the customer's fixed landline through which the service is supplied (again, this includes a country code).

- any other commercially relevant information, e.g. gift cards unique to a specific Member State, the consumer's trading history with the retailer.

A service purchased *locally*, such as a Wi-Fi connection in a hotel, or use of an internet café, includes the local VAT rate and should be assigned to the HICP of the country where the service is provided.

Purchases of broadcasting and telecom services are included in the HICP on the basis of the consumer's place of residence, which would be the country where the contracts are signed. If a consumer on holiday buys additional internet access for their mobile phone, it is purchased from their original provider.

For electronic services — especially over-the-top services, provided by a third party and delivered to a consumer, with the internet service provider simply transporting the data packets (e.g. purchasing an e-book on a mobile phone using a hotel's Wi-Fi hotspot) — the retailer has to keep any two pieces of non-contradictory information (as listed above) as evidence of the customer's location. Assuming the tourist does not change SIM cards, bank accounts and billing addresses, the VAT rate will most likely still be that of the country of residence.

Such services should therefore be assigned to the HICP of the purchaser's country of residence, as the country of regular delivery.

The alignment of the HICP Recommendations for the treatment of cross-border internet purchases with the VAT rules should also make it possible to improve the weights for digital services and internet purchases in the HICP.

7.2.4.4 Extra costs (Recommendation 4)

Buying goods and services online may involve unavoidable costs on top of the advertised product price. Examples include:

- delivery charges,

- credit/debit card fees,

- administration/booking fees,

- charges for supplementary services.

These extra or additional costs are often higher and more significant than for purchases in physical outlets. For air tickets bought online, in particular, the additional charges may represent a significant proportion of the total price. They are generally unavoidable, in contrast with the situation as regards purchases made in traditional outlets, where consumers take their purchases home themselves and can, if they so wish, pay in cash, thus avoiding credit card and delivery charges.

The price which should be recorded for the HICP is the full price, *including* any compulsory additional costs, provided that the additional costs arise solely from the purchase of the product concerned. This is consistent with the intentions underpinning the definition of a product offer given in Regulation No 1749/96 Article 2(2):

'Product offer means a specified good or service that is offered for purchase at a stated price, in a specific outlet or by a specific provider, under specific terms of supply, and thus defines a unique entity at any one time.'

The rule on the treatment of additional costs is based mainly on issues of practicability. If such costs can be assigned to a specific purchased good or service, they should be included in its price. However, if several products are purchased simultaneously and the additional costs cannot be assigned to each individual product, they should be registered elsewhere. Credit card fees, for example, should be assigned to Financial Services.

Note that charges for using debit or credit cards to make purchases made using the internet are charged by the seller and are therefore unavoidable, as cash is not an option. Charges incurred by a consumer on holiday when making purchases in physical outlets or withdrawing local currency from ATMs are charged by the consumer's bank. They are charges for a financial service, not part of the product's purchase price. Section 12.8 makes it clear that any card fees charged by the card supplier in connection with such purchases are to be assigned to the purchaser's country of residence.

ECOICOP generally requires that delivery charges be included in the same category as the associated product. Thus, the charge for delivering a book ordered online would be included in the cost of the book and classified accordingly. The same applies to deliveries of larger goods, such as durables, where ECOICOP explicitly includes delivery and installation charges. Where a single delivery charge covers several products from different ECOICOP categories (which can be the case for online purchases of food and beverages), expenditure on the delivery charge should be assigned to ECOICOP 08.1.09 (Other postal services).

7.2.4.5   Other distance purchases (Recommendation 5)

This category covers purchases by mail order and phone. Although these have been in existence for a long time, they have not always been treated as separate outlets in the HICP. However, they do share some of the features of online purchases. Firstly, the customer has no face-to-face contact with the seller. Secondly, customers usually pay in a way similar to that used for online purchases: by credit or debit card, or bank transfer. Additionally, such purchases may incur delivery charges which there is no way to avoid. All such unavoidable charges should be included in the price recorded.

It has been decided that these types of transaction should be dealt with in the HICP in the same way as internet transactions, although they are not classified as e-commerce. Accordingly, the same rules are to be followed. These include rules on the country to which the purchase is assigned, the way in which services are dealt with, and how extra/additional costs (such as delivery) are to be categorised.

7.2.5   Weights and sampling

No specific recommendation has yet been made on this topic. However, it is often difficult to obtain appropriate weights for online purchases. The obvious source at the appropriate ECOICOP level is National Accounts and the household budget survey. It is important that the household budget survey include specific questions on the volume of internet purchases, broken down by product groups. VAT records from tax authorities should be useful for estimating weights (to what level of detail is currently not yet clear). They may also be able to distinguish to some extent between household and business expenditures.

As regards outlet sampling, the usual procedure for non-internet outlets is to construct a target universe of outlets and then use an appropriate sampling method (see Chapter 4). With online purchases, the target universe of sellers is often unknown and can, in theory, be large, as goods can be shipped from almost anywhere. This means more subjective sampling methods must be used based on information from e-commerce surveys or organisations with knowledge of that field. A characteristic of the online retail trade is that some markets (books, clothing, music downloads, etc.) are dominated by relatively few large retailers. A subjective sampling of the major retailers in these market sectors should be good enough in most cases. Product suppliers that have both physical and internet outlets should normally be allocated separate weights for each type of outlet.

Online prices can be conveniently collected by manually recording the information available on websites. Alternatively, web-scraping techniques can be used to *automatically* collect prices (see Chapter 5, Price collection). In all cases, care should be taken to record the price with the correct VAT rate.

The prices of some products available online may change more frequently than their equivalents sold in traditional physical outlets. Where this happens, price collection and weights estimation methods may also need to be more variable.

7.3 Service charges proportional to transaction values

7.3.1 Introduction

Many services have, as with goods, stated prices payable for a specific service such as a bus journey, a haircut or a theatre ticket. But there is a separate class of services whose prices are given as a proportion of the value of the associated product.

The fee charged by an estate agent for arranging a rental contract will often be a fixed proportion of the rental value. It may, for example, be one month's rent or a percentage of the monthly or annual rent. Many fees for financial transactions are similarly presented (see Section 12.8). But even with transactions relating to saving rather than consumption (such as the purchase of shares, which are beyond the scope of the HICP) some fees for associated services, e.g. stockbroker fees, are still included in the HICP.

This method of charging, sometimes referred to as ad valorem charges, raises the question of the impact of changing values on inflation. If rents are rising, there is no question that this contributes to inflation, and indeed rental values are covered in the HICP. But if an estate agency keeps its proportionate fee fixed, the value of the fee will nevertheless rise as rents increase. Does this also contribute to inflation? Regulation No 1920/2001 confirms that it does, and shows how it should be included in the HICP.

It can be seen that the price index for this type of charge may be driven by changes in either or both of the two components: the price of the underlying product (e.g. rises in actual rents) and the *price* of the specific service charge (e.g. the agency's commission rate). The base price must therefore comprise two components: the underlying price of the product; and the price (or rate) of the associated commission or charge.

A practical difficulty is that the price for an ad valorem transaction is usually not directly observable. Where a service charge is expressed as a proportion of the transaction value, it has to be valued (modelled) for the HICP using a representative unit transaction from the price reference period (December of each year). That is, applying the observed fee proportion to the value of the representative unit transaction gives a price in monetary terms for the service; this is the price that is entered into the HICP.

The specifications of a representative unit transaction may change during the current period, just as the specifications of an ordinary product offer may change. In such cases, quality adjustment may be needed to preserve the comparability of the transaction before and after the change. (See Regulation No 1920/2001 Article 3(2), quoted in Section 7.3.2).

Examples of various types of calculation are given in Section 7.3.4. These cover stockbroker fees, foreign currency exchange and estate agency fees. The common aspects of these examples are that representative transactions should be typical of consumer purchases, just as representative items are selected for the pricing of products within elementary aggregates. The amounts involved should be large enough to capture changes in both fixed and ad valorem fees.

It should be noted that FISIM (Financial Intermediation Services Indirectly Measured — ECOICOP 12.6.1) are not covered by the HICP.

Situations where fees for certain services are income-dependent have some similarities with proportional charges. An example is nursery school fees that depend on parental income. Such situations are covered in Section 12.1.

This part of Chapter 7 continues with the legal requirements (Section 7.3.2) followed by definitions (Section 7.3.3). These are followed by a detailed explanation of the methods to be used to calculate the appropriate prices and weights for the HICP.

Annex 7.3 contains details of the algebra involved in calculating proportional service charges.

7.3.2 Legal framework

The subject of service charges proportional to transaction values is addressed in Commission Regulation (EC) No 1920/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of service charges proportional to transaction values in the harmonised index of consumer prices and amending Commission Regulation (EC) No 2214/96 [50]. The Regulation deals with how the HICP treats service charges generally, and covers in somewhat more detail the principles involved in dealing with service charges which are proportional to transaction values.

Article 3 of the Regulation states:

'1. The HICP sub-indices concerned shall be calculated using a formula which is consistent with the Laspeyres-type formula used for other sub-indices. They shall reflect the price change on the basis of the changed expenditure of maintaining the consumption pattern of households and the composition of the consumer population in the base or reference period.

(a) The purchaser prices of services to be used in the HICP shall be the actual charges levied directly on consumers in exchange for the service provided. The HICP shall include charges expressed as a flat fee or flat rate.

(b) Changes in purchaser prices which reflect changes in the rules determining them shall be shown as price changes in the HICP.

(c) Changes in the purchaser prices resulting from changes in the values of the representative unit transactions shall be shown as price changes in the HICP.

(d) The representative unit transactions shall be expressed in physical terms, except where this is not appropriate or possible, in which case they shall be expressed in the currency of the Member State.

(e) The change in the values of the representative unit transactions may be estimated by the change in a price index which represents appropriately the unit transactions concerned. Where they exist, HICP sub-indices or aggregate indices shall be deemed appropriate for this purpose.

2. Where the specification changes, prices shall be treated in accordance with the rules on specification changes, and in particular those regarding quality adjustment as laid down in Article 5 of Regulation (EC) No 1749/96.

3. Where services have been made available to consumers free of charge and subsequently an actual price is charged, the change from zero to an actual price, and vice versa, shall be reflected in the HICP.'

7.3.3 Definitions

Note: the following two definitions have no legal status; they are given purely for guidance.

Representative unit transaction: a typical transaction nominated for pricing in the price reference period, for which the price can be estimated.

Revaluing index: an index chosen to represent changes in the *value* of a representative unit transaction.

7.3.4 Methodological guidance

Service charges proportional to transaction values are most commonly found in the area of financial services — ECOICOP 12.6.2 Other financial services not elsewhere classified. Section 12.8 discusses the detailed methodology relating to financial services (both flat fees and proportional charges) in detail, giving specific guidance on how to treat foreign currency exchange; investment funds; stockbrokers' services; and financial advisers and tax consultants.

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[50]   OJ L 261, 29.9.2001. p. 46, and corrigendum published in OJ L 295, 13.11.2001. p. 34.

To illustrate the principles involved in measuring proportional services charges, three illustrative examples are given below:

- stockbroker fees;

- foreign currency exchange;

- estate agency fees.

Stockbroker fees

A problematic example illustrates the application of the rules in Article 3 of Regulation No 1920/2001. It concerns the stockbroker fees charged for a purchase of a block of shares or securities. Stockbrokers buy or sell shares or other securities on behalf of clients. The service provided consists of arranging for a transaction to take place on conditions specified by the client, i.e. a given block of shares is bought or sold. Usually, clients are charged in proportion to the value of the block of shares traded. The proportional charge is often combined with a minimum charge.

The first stage is to determine the weights for this product. In principle, weights are obtained from the household budget survey, but, as is well-known, response from the higher-income households tends to be relatively low, and is likely to provide underestimates for this particular service. This means it is usually necessary to find alternative sources (such as the national accounts). If the estimated weights are below the threshold for inclusion in the HICP, then no further action need be taken to obtain prices. Assuming, however, that this is not the case, the next task is to determine a *representative unit transaction*, and perhaps several.

For stockbroking, purchasing or selling of shares, unit trusts or other securities, the representative unit transaction should be the charge payable by consumers in exchange for trading a set basket of securities (defined in value terms) which are representative for the base or reference period.

The amount invested in stocks during the price reference period (i.e. the value of the investment) should also be kept constant. The all-items HICP should be used to adjust the transaction values so as reflect changes in percentage charges. Price indices relating to the stock market or other securities should not be used. This approach thus maintains expenditure during the reference period constant in real terms [51].

The representative unit transaction should be the trading of a basket of shares (or other securities). The value of this basket should be adjusted by the overall (all-items) HICP as the revaluing index (see Section 12.8.6 for further explanation). In other words, the representative unit transaction is the trading of shares with a given value in real terms, that is, in constant euros or a national currency.

The choice of the representative unit transaction is dictated in a similar way to the choice of other products to be priced as *representative products* throughout the HICP basket. They must be typical examples of the product concerned, and likely to be available for pricing for a reasonable length of time. They must also, of course, be capable of being priced. In this example, a representative unit transaction could be the trading of a portfolio of shares with a value of €7 500. In the price reference period, the service charge could comprise:

- a flat fee of €10, and

- a proportional fee of 5 % of the total value of the shares traded.

These charges total €385 (€10 plus €375). This amount is the base price of the price reference period of the representative unit transaction (product).

In a later period, the flat fee may have risen to €15, while the proportional fee remains at 5 %. However, over time the value in real terms of the unit transaction in the base or reference period will probably decline because of inflation. To maintain its real value so as to appropriately estimate the change in the service charge, we must therefore uprate the base value of €7 500 by an appropriate index, which, as stated above, should in this case be the all-items HICP. Suppose the all-items HICP had risen by 17 % between the price reference period and the second period. The initial value of the portfolio is thus assumed to have risen by 17 % as well, to €8 775. The total transaction would then be priced at €15 plus 5 % of €8 775, which comes to €453.75. The index for this representative transaction is thus 453.75/385 = 117.9.

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[51] See Annex 7.3.

It can be seen that without the fixed stockbroker fee, the index for the proportionate fees will always be identical to the all-items HICP. In the above example, it is slightly higher because the flat fee has risen at a higher rate (50 %) than the HICP.

It might be thought that to replicate the usual method for pricing goods in retail outlets, the basket of shares would have to be identified as, say, 1 000 Class A shares in Company X. But this is irrelevant, as company and share class do not normally determine brokerage fees, and the unit transaction is a fixed investment expressed in monetary terms — in this case €7 500.

Foreign currency exchange

The output of any financial intermediary can, in principle, comprise two components:

(a) financial intermediation for which no explicit charges are made (FISIM — ECOICOP 12.6.1), and

(b) financial intermediation services for which commissions or fees are explicitly charged. In some Member States, no explicit charges are made on the purchase or sale of foreign currency, but a wider spread between the selling and buying exchange rates is used. Consumers pay only an implicit charge for the services in such cases, and since they fall within Financial Services Indirectly Measured (FISIM), the transactions are excluded from the HICP. The weight for currency exchange may thus be either very small or negligible in these Member States. Regulation No 1920/2001 covers only those financial services for which explicit charges are made.

Commission for the exchange of foreign currency is usually expressed as a proportion of the value of the foreign currency received in exchange for a given amount of national currency (or vice versa). There may also be an additional flat-rate fee, for example where currency is exchanged by ATM. Services related to currency exchange for which proportional charges are levied must be defined on the basis of specific transactions. Charges in connection with selling or buying foreign currency correspond to two distinct services and should be dealt with separately in the HICP.

The representative unit transaction should be expressed as the charge payable by consumers to exchange a specified amount of currency considered representative for the base or reference period in the economic territory of the Member State concerned. An example is the charge for changing €200 into pounds sterling.

The revaluing index should in theory be based on an official exchange rate whose values can be directly observed. However, given the large daily fluctuations which can occur in exchange rates, a moving average of one or more months might be considered more appropriate. Calculations may then be made in the same way as those described in the previous example. Section 12.8.6 discusses the measurement of foreign currency exchange in more detail.

Estate agency fees

Estate agents who deal with the purchase of properties by households usually charge a fee by reference to the purchase price of a property when it is finally sold. However, the HICP does not currently cover transactions involving sales and purchases of dwellings. Estate agents also charge proportional fees for the services they perform in letting dwellings for rent. These fees usually relate to the rental cost of the dwelling, and there may be additional one-off fees at the start of a rental period. For example, a particular agency may charge a flat fee of €150 for a new tenancy, plus a fee of one month's rent, so the higher the rent, the higher the fee.

The method is similar to that described above for stockbroker fees. Firstly, the weight must be determined; this should normally be obtainable from the household budget survey or national accounts, provided that the distinction is made between expenditure on actual rents and expenditure on agency fees. Secondly, a representative unit transaction must be selected; this could be the average rental for a property in the base or reference period. Here it may perhaps be suitable to select more than one, to represent different types and sizes of properties whose price developments may differ.

Some estate agencies may simply charge one month's rent as commission on letting a property. Others may also charge a fixed fee. Assume that one of the representative unit transactions that has been chosen is the letting of an apartment with an annual rental of €3 600. Agency A charges the tenant a fee equal to one month's rent, i.e. €300, plus a flat-rate fee of €350. Agency B charges two months' rent, but with no flat-rate fee. The base period fee for Agency A is €650, while that for Agency B is €600.

Twelve months later, survey data shows that Agency A has changed its fee structure: the flat-rate fee has been increased from €350 to €400. No other changes are recorded.

It has been decided to use the HICP for rental prices (ECOICOP 04.1.1/2) as the revaluing index. This shows an increase of 6 % over the year in question.

The fee charged by Agency A is now based on a revalued rent of €3 600 plus 6 %, which comes to €3 816. The flat-rate fee is now €400 and the proportionate fee €318, totalling €718. This is an increase of 10.5 % over the original fee.

The fee charged by Agency B is also based on a revalued rent of €3 816, and amounts to €3816/6 = €636. This is an increase of 6.0 % — identical to the revaluing index, as there is no flat-rate fee.

Just as with sub-elementary aggregate indices for most product offers, there are no weights available for the above indices. The treatment is the same as usual for ordinary product offers: the observed prices are aggregated, using the appropriate formula for elementary aggregate indices.

Annex 7.3: Modelling charges proportional to transaction values

This technical introduction sets out the algebra for the HICP as far as charges proportional to transaction values are concerned.

The changes in a proportional charge resulting from changes in transaction values to be captured by a given HICP sub-index j can be modelled as follows:

The proportional service charge c equals the percentage rate r applied to the value v of a unit transaction — which is the price of the transaction unit — times the quantity or number of transactions q in the base or reference period.

$$c = r * v * q = r * V \tag{7.3.1}$$

where $V = v * q$.

If $_0i_t$ is an index that appropriately reflects the movement in the value of the unit transaction (i.e. the price of the service) from period 0 to t, i.e. $_0i_t = v_t/v_0$, the price-updated proportional charge c at time t for the same set of transactions sampled at 0, i.e.:

$$V_t = v_t * q_0 \tag{7.3.2}$$

can be written as:

$$c_t = r_t * V_t = (r_t * {_0i_t}) * V_t / {_0i_t}$$

$$= (r_t * {_0i_t}) * v_t * q_0 * v_0 / v_t = (r_t * {_0i_t}) * (v_0 * q_0) \tag{7.3.3}$$

The HICP sub-index j is then

$$_0j_t = \sum[(r_t * {_0i_t}) * (v_0 * q_0)] / \sum[r_0 * (v_0 * q_0)] = \sum[(r_t/r_0) * {_0i_t} * w] \tag{7.3.4}$$

with

$$w = (r_0 * v_0 * q_0) / \sum[r_0 * v_0 * q_0] = (r_0 * V_0) / \sum[r_0 * V_0] \tag{7.3.5}$$

The price change in the proportional service charge is thus given by

$$(r_t/r_0) * {_0j_t} \tag{7.3.6}$$

i.e. the change in the percentage rate times the estimated change in the value of the representative unit transaction.

Once the base or reference period weight has been estimated according to (7.3.5), expression (7.3.6) reduces the estimation problem to:

- constructing an appropriate elementary aggregate and the corresponding elementary aggregate index in order to capture the movement (r_t/r_0), and

- choosing an index $_0i_t$ which appropriately reflects the change in the value of the representative unit transaction. Although a monthly price updating of the base or reference year expenditure is not necessary, the criterion for selecting this index is its ability to price-update the base or reference period expenditure for the transactions connected to the service concerned.

7.4 Tariffs

7.4.1 Introduction

The formal definition of a tariff is given in Regulation No 2646/98 Article 2(1):

'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. Tariffs are not negotiable for households.'

This definition is consistent with the one given in the ILO CPI Manual, paragraph 9.14: 'A tariff is a list of prices for the purchase of a particular kind of good or service under different terms and conditions'.

An example of a simple tariff is a case of domestic electricity prices, see Table 7.4.1.

Table 7.4.1 Price of electricity for domestic households

Monthly standing charge	€3.00
First 200 units of energy (kWh): cost per unit	€0.20
Subsequent units (kWh): cost per unit	€0.10

A *component element* would be one of the above three elements of the tariff. The price of each component can be changed separately: the electricity company can change the standing charge, or the price of the first 200 units or the price of units above 200. It can also change the 200-unit threshold (which can be the most difficult aspect for the price statistician to deal with).

A *unit of consumption* would be 1 kWh in the above example. A consumer using 350 units in a month would pay a total of €58. A consumer using 150 units would pay €33. A consumer who used no electricity in the month would pay €3. This type of tariff, which may be said to be based on quantities supplied, is sometimes referred to as a *block tariff*. Other types of tariff exist, such as those based on types of consumer (child/adult/pensioner, season ticket holder/non-season ticket holder), and *on demand* conditions, such as time of supply (day-time fares, night-time fares). These different types of tariff can sometimes be combined. Electricity prices are an example, as they may depend not only on quantities supplied but also the time of day or night when electricity is used.

Although many tariffs relate to the sale of services rather than goods, a tariff may, for example, be applied to sales of goods at different unit prices, depending on the quantity being bought at any one time: the larger the quantity, the lower the unit price.

The treatment of tariffs covering services is affected by 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 when constructing a 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 smaller types of expenditure that may be priced separately, but are typically only available as a part of a package. (See Section 7.6 — bundles);

- Services are often provided under long-term contractual arrangements, which may include different types of customer loyalty rebates, clauses for the minimum duration of contracts, surcharges for the provision of services not provided for in the contract, etc.;

- 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. Tariffs may be structured in such a way as to prevent direct comparison with other providers operating in the same markets. When different companies' tariffs are compared, the elements of the pricing schemes and details in the contents of the plans provided often turn out to be somewhat different. This is particularly marked in the field of mobile telecommunication services (see Section 12.6.);

- There may 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 or internet provider offers a number of different pricing packages targeting different patterns of use, existing customers may undertake periodic reviews during which they may decide to move to a more advantageous tariff for their own level of use.

The treatment of tariff prices must be consistent with the treatment of other prices in the HICP. This is a basic principle. In particular, the Laspeyres principle of base-period weighting needs to be applied in specific ways when it comes to tariffs. Thus, changes in tariff prices should reflect the price change on the basis of the changed expenditure required to maintain the same consumption pattern of households in the base or reference period, i.e. before the change in the tariff.

7.4.2 Legal framework

Commission Regulation (EC) No 2646/98 of 9 December 1998 laying down detailed rules for the implementation of Council Regulation 9EC) No 2494/95 as regards minimum standards for the treatment of tariffs in the Harmonised Index of Consumer Prices [52] sets out the required treatment of tariffs for the HICP:

'Article 5 — Procedure

HICP sub-indices containing tariffs shall be calculated using a formula consistent with the Laspeyres-type formula used for other sub-indices. They should reflect the price change on the basis of the changed expenditure of maintaining that consumption pattern chosen by households prior to the given change in the tariff and where, after that change:

1. *a component element or a unit of consumption remains unchanged with respect to its specification, then the price for that element or unit according to the old and the new tariff shall be directly compared and the price difference taken into the HICP;*

2. *a component element or a unit of consumption changes with respect to its specification, or a new component element is added which does not constitute a new good or service for the consumer, then the price change shall be computed with weights corresponding to the expenditure of preserving the pattern of consumption applying during a period, up to one year, preceding the change. The adjustments for specification changes shall be consistent with quality adjustments made for other sub-indices;*

3. *a component element or a unit of consumption with a new and distinct specification constituting a new good or service for the consumer is added to the tariff, it shall be treated as 'newly significant goods and services' as defined in Regulation 1749/96. If the expenditure on the new good or service is significant it shall be taken into the index by linking from the month when the new tariff comes into force using an estimate of expected immediate consumption or within a period of 12 months otherwise.'*

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[52]   OJ L 335, 10.12.1998. p. 30.

7.4.3 Definitions

Definitions included in Regulation No 2646/98

Tariff: 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 determined by the supplier, by the government or by agreement, to influence consumption patterns by differentiating prices and conditions according to the characteristics of consumers or the level, structure or timing of the act of consumption. Households cannot negotiate tariffs.

Tariff price: a price within a tariff that applies to a component or unit of consumption of the good or service in question.

Other definitions

Component: one of the elements of a tariff list which carries its own price.

Homogeneous: tariff elements which are of a similar type and are measured in the same units.

7.4.4 Methods of treating tariff prices in the HICP

7.4.4.1 General procedure

The electricity example in Table 7.4.1 demonstrates the situation if the standing charge or the unit price for electricity usage were to change either below or above 200 kWh (or both). For each level, there is a measurable price change, and these price changes must be reflected in the HICP. The problem is how to weight the changes together.

To put this another way, using the above example, if one of the tariff component elements were to change (say, the 200-unit threshold were changed to 250 units), the tariff would be re-priced on the assumption that consumers are not sensitive to changes in the tariff, so they do not change their pattern of consumption in response to the tariff change. Thus the consumer who used 350 units per month would continue to use 350 units per month. Under the new tariff, the three types of customer above would therefore pay €63, €33 and €3 respectively. The calculation of the overall price change, however, depends not only on the component price changes but also on the appropriate weights — see Section 7.4.4.5.

The circumstances described in Regulation No 2646/98 Article 5(2), would include the situation mentioned above where the 200 kWh threshold is changed. (The *specifications* of the second and third elements of the tariff would then have changed, since 200 kWh is replaced by 250 kWh.) The Regulation also covers another situation, for example, if a second threshold were added to the tariff: *units consumed between 200 kWh and 500 kWh*. (This would also affect the top threshold, which would now be units over 500 kWh.) The new component does not constitute a *newly significant product;* the product is still the electricity consumed. But in this case we must apply the principle of *no change in consumption* following the tariff change. The regulation specifies a period of time — up to one year before the tariff change — for which the previous consumption pattern must be assumed.

The situation described in Regulation No 2646/98 Article 5(3) refers to a less common occurrence, where an existing tariff is changed to include a newly significant product. The general method for dealing with newly significant products is covered in Chapter 4. An example might be the addition of on-demand movies or a live sports channel to an existing subscription TV service package, or a move from providing these options free of charge to making an explicit charge for them. (See also Sections 7.5 — Zero prices and 7.6 — Bundles.

Some types of service, such as transport, have only one tariff, and when a component changes, all or nearly all consumers are affected by that change at the same time. Such changes should be dealt with as described in this section. However, for some other types of service, most notably telecommunication services, many different tariffs co-exist on the market. When new tariffs replace old tariffs, a frequent occurrence in this sector, only new customers pay the new tariff price. Existing customers are often bound by contract to the replaced tariff, and do not move to the replacement tariff until their existing contract expires. To capture the correct price change facing all consumers, it is often preferable to phase in new tariffs over time, to reflect the changing proportion of consumers

who are subject to the replacement and the replaced tariff respectively. These changes between tariffs are referred to as *migration rates*. Migration rates, and how they should be applied, are discussed in detail in Section 12.6 (telecommunication services). The principles discussed in Section 12.6 can be applied to other types of service if the market situation is similar to that of telecommunications services.

Regulation No 2646/98 Article 5(2) refers to possible quality adjustments. In the above example, quality adjustment may be required if a new service element, such as a live sports channel which was previously an optional extra, is added to a subscription TV service/package without any additional charge, or, vice versa, if such an option was included as part of a package but now attracts an additional charge; see Section 7.4.4.6.

7.4.4.2   Types of tariff

It is helpful to distinguish four broad types of tariff, which cover the vast majority of tariffs in general use:

a.   Tariffs based on demand conditions (e.g. peak-load pricing; limited availability);

b.   Tariffs dependent on the type of customer (e.g. children, adults, students, pensioners);

c.   Two-part tariffs:

  (i)   charge for the right or permission to use a product,

  (ii)   charges for actual usage (e.g. landline telephone services which often comprise a line rental charge plus usage charges);

d.   Block pricing (e.g. units charged at different prices depending on the volume of consumption, e.g. coal or fuel oil, which may attract different unit prices depending on the quantities purchased).

Each Member State should check carefully which tariffs are significant enough to be included in the HICP and exist in that particular country, and into which categories they fall. Note that some tariffs may fall into more than one category.

Examples of the four categories or types of tariff are given below.

a. Tariffs based on demand conditions

Tariffs based on demand conditions may be created because of the need to ration or smooth out the consumption of a service which has limited availability. Thus, electricity companies may have a cheap night rate to encourage consumers to shift as much as possible of their electricity consumption to night time (when demand is generally low). This reduces overall demand during the day, when demand is normally higher. This approach is sometimes called *peak-load pricing* or *congestion pricing*. Another example, also dependent on the time of day, is a bus company tariff: fares between, say, 6.30 a.m. and 9.30 a.m. may be higher than at other times. This is because there are more passengers at these peak travel-to-work times. After 9.30 a.m., prices may fall to encourage travel outside the rush hour.

b. Tariffs dependent on the type of customer

This type of tariff may sometimes appear indistinguishable from *discount prices*. (See Chapter 5.) Typical types of customer include: pensioners, students, children, families, foreigners (*dual pricing*), unemployed people, and annual subscribers (e.g. to magazines).

c. Two-part tariffs

There are many examples of this type of tariff. A simple case is that of a metered taxi fare: it is often the case that the taxi meter starts to tick even before the journey has started; this is a *standing charge* which must be paid before the charge per distance (and/or time) travelled is levied. It is a pre-condition of travel in the taxi.

The concept of a standing charge is also applied to many other types of tariff. For example, with utilities such as electricity, gas, landlines, water and sewerage, customers often have to pay a certain set amount separate from the usage charge. Often there is a clear commercial reason for the standing charge, such as the provision of a meter

or a telephone line, which has a cost regardless of the volume of usage. Apart from utilities, such tariffs may also be found in amusement parks, where there is an entry fee plus a charge for each activity (such as a ride on a roller-coaster). A discount club, where a subscriber has to pay for a membership card to benefit from discounts, is another example of a 2-part tariff.

d. Block pricing

This has been illustrated above in the context of electricity tariffs. It often applies to other utilities, such as gas and water supply.

Some tariffs fall into more than one of the above categories. An electricity tariff may have:

- a time element (cheap night-usage),

- a type-of-customer element (cheaper for older customers),

- block pricing (the first units charged at a higher unit price than subsequent units),

- and a two-part element (standing charge regardless of actual usage).

7.4.4.3   Price measurement methods

There are essentially four types of measurement available for the pricing of tariffs:

a. Representative unit transactions in matched pairs of elements. In this method, changes in the component tariff prices are compared in different periods, and combined using weights applicable to the individual components of the tariff.

b. Representative unit transactions defined by specified consumer profiles. In this method, a set of representative consumption or usage patterns of customers is defined. The price followed is the minimum price for the specified consumption/usage profile from a specified provider. This contrasts with the pricing of a set of component prices as used in the other approaches. The same profiles can be used for pricing the tariffs of different suppliers.

c. Sample of bills/actual usage. This method uses actual transaction data obtained from the suppliers of the good or service to customers, classified by consumption profiles.

d. Unit values. Where none of methods (a) to (c) is possible, and the components of the tariff are homogeneous, the average price change resulting from a tariff change may be calculated using overall revenue and quantity data, as supplied by the provider of the good or service. An example would be the mean cost of supplying one unit of electricity to all customers. This method should be used only if it is impossible to measure the price changes using one of the other methods.

Details of each method are given below.

a. Representative unit transactions in matched pairs of elements

In this method, changes in tariff prices are compared using weights applicable to the individual components of the tariff.

This method is consistent with the normal method of calculating price changes in the HICP. The price of each element of a tariff is monitored just as with a normal type of product offer. Ideally, weights should then be applied to each element so as to calculate an average tariff price change. Otherwise, the average can be calculated in the same way as for an elementary aggregate index, e.g. using the geometric mean (Jevons) formula. The tariff price itself may fall within an elementary aggregate if its total weight is low or unknown.

An example relating to a bus fare tariff is given in Table 7.4.2.

Table 7.4.2: Tariff calculation with matched pairs: bus fares

Tariff elements	Quantities:	Prices: Fares (€)		Revenues (€)		
	No. of passengers	Period 1	Period 2	Period 1	Period 2	Change in revenues
Non-pensioners — peak time	2 000	0.40	0.50	800	1 000	1.250
Non-pensioners — off-peak time	3 000	0.30	0.25	900	750	0.833
Pensioners — peak time	100	0.20	0.50	20	50	2.500
Pensioners — off-peak time	1 000	0.15	0.13	150	130	0.867
Total	6 100			1 870	1 930	1.032

It is easy to calculate that the total expenditure (or revenue, from the point of view of the bus company) was €1 870 before the tariff change and €1930 afterwards. The increase is thus 3.2 %.

It is worth noting that if no passenger numbers (i.e. weights) were available for each of the components, and it was decided to assume that they were equally weighted i.e. 1 525 passengers in each component), the result using the Jevons (geometric mean) formula would have been 23 %, and with the Dutot formula 31 %. The fact that the true increase is only 3.2 % is attributable largely to the low weight (under 2%) given to the component for pensioners travelling at peak time – while their increase was by far the largest of the four components. This example thus shows the importance of having weights for each tariff component. Normally these can be obtained only from the provider of the product, and because usually such information is commercially confidential, the Member State concerned may have to put some pressure on the provider to release the necessary data — and to update it if and when the weights change significantly. It may, in fact, be necessary to invoke Article 5(3) of Regulation (EU) 2016/792.

It may not always be necessary to monitor the price of every single component of a tariff. Some are likely to be more important than others in terms of weight. Instead, representative components may be chosen, and the average tariff price change is calculated on the basis of these components alone.

Note also that the above calculation assumes no change in the numbers of passengers travelling in each fare component, although one would expect some change in response to the various fare changes. The reason for this is the principle set out in Regulation No 2646/98 Article 5(2): *no change in consumption* following a tariff change.

This method may be appropriate to tariffs of types (a) and (b) in Section 7.4.4.2. In general, it should not be used in situations where there are major changes in tariff structures, or where the structures of tariffs are regularly changed (i.e. during the year), for example mobile telephones (see Section 12.6).

b. Representative unit transactions defined by consumer profiles

In this method, a set of consumption patterns (or profiles) for consumers are defined as being representative of typical consumers of the tariff concerned. Consumer profiles should be derived from real data, which must be anonymised, or expert advice from the supplier or organisation which represents or regulates the industry.

The price to be collected is the price of the tariff which meets the minimum usage requirement of the specified consumer profile from a specified provider. Through time, the tariffs offered may change in terms of their components. However, as this method follows a fixed pattern of use rather than a fixed bundle of tariff components, it is not necessary to make any quality or quantity adjustments when new tariffs replace old ones. However, it is recommended that the selected consumer profiles are reviewed and updated annually to ensure that they remain representative of consumer behaviour.

It is generally necessary to develop a number of consumer profiles to cover consumers' typical usage patterns, which for some services such as telecommunications can vary substantially. These may be usage profiles, such as low-usage, medium-usage and high-usage consumers. Each of the consumer profiles priced should be weighted using expenditure weights also provided by the supplier or the regulator. Indices are calculated for each provider company, which are then weighted together using expenditure weights relevant to each supplier.

This method is appropriate to tariffs of all types (a) to (d) in Section 7.4.4.2, and it is particularly useful for types (c) and (d). An important advantage is that the method is able to reflect price trends correctly when tariff structures change and elements are not comparable over time. However, it should not be used in cases where it is not possible to define typical consumers.

This method is greatly improved if migration rates are applied. Section 12.6 (telecommunication services) discusses both this approach and migration rates in more detail, providing numerical examples.

c. Sample of bills/actual usage

This method uses transaction data obtained from the suppliers of the good or service to customers classified by characteristics. In this method, the supplier agrees to provide the Member State with anonymised copies of actual bills reflecting the selected customer types. The method reflects actual customer behaviour by reference to real bills.

This method may be appropriate to tariffs of type (b) in Section 7.4.4.2. However, it should not be used in cases where, for any reason, it is not feasible to make sufficiently precise definitions of typical customers.

In practice, many Member States find it difficult to persuade suppliers to provide samples of bills, so this method should not normally be relied upon for dealing with tariffs.

d. Unit values

Where none of methods (a) to (c) is feasible, and the elements of the tariff can be finely stratified and are homogeneous, the average price change resulting from a tariff change may be calculated using overall revenue and quantity data supplied by the provider of the good or service.

The method has the advantage that there is no sampling within the tariff and no need to specify representative items or different customer types. However, it suffers from the usual disadvantages of using unit values in a CPI: they should not be calculated for sets of heterogeneous products. It also depends on the suppliers providing commercially sensitive data regularly and in good time. This method should therefore be used only in situations where none of the other methods is feasible, and should in any case not be used where the elements of the tariff are heterogeneous.

A straightforward example of the calculation of unit value indices is shown in Table 7.4.3.

Table 7.4.3 Calculation of unit value indices

Quantities purchased			
Item	**M1**	**M2**	**M3**
A	150	150	140
B	46	48	56
C	75	75	87
Total	271	273	283
Revenues			
Item	**M1**	**M2**	**M3**
A	3 000	3 300	2 940
B	1 702	1 536	1904
C	4 950	4 950	5 481
Total	9 652	9 786	10 325
Unit values			
	M1	**M2**	**M3**
Total	35.62	35.85	36.48
Unit value indices			
	M1	**M2**	**M3**
Total	n/a	1.006	1.0244

The top two sections of Table 7.4.3 (quantities purchased and revenues) contain the inputs (data relating to items (components) within a tariff). In the third section, the unit values are calculated as the revenues divided by the quantities, e.g. 35.62 = 9652/271. The bottom section contains the Unit Value Indices. Thus, 1.006 = 35.85/35.62.

7.4.4.4　Classification issues

Most tariffs fall within an existing elementary aggregate — and hence a single ECOICOP 5-digit sub-class or 4-digit class — so there should usually be no problem with classification. For example, the electricity example given in Table 7.4.1 would fall entirely within ECOICOP 04.5.1. However, a single tariff can sometimes include components which fall into more than one elementary aggregate, or even more than one ECOICOP class or sub-class. In such cases, the tariff, together with all its components which are being priced, should be assigned to the ECOICOP class or sub-class which covers the greater part of the tariff expenditure, and within a single elementary aggregate of that class or sub-class. This corresponds to the recommended way of dealing with bundles (see Section 7.6).

An example is mobile phone tariffs, where a single tariff may include not only the various services associated with mobile phones, but also the handset itself. The handset, if separately purchased, would fall under ECOICOP 08.2.0.2, but if the handset is included in a tariff without an identifiable charge, the entire tariff would fall under ECOICOP 08.3.0.2.

In other cases, a decision must be taken on the class to which the tariff is to be assigned. In line with the HICP Recommendations on the treatment of bundles (see Section 7.6), both prices and expenditures should be allocated to the ECOICOP class that accounts for most expenditure.

7.4.4.5　Data sources for weights

In calculating a tariff's overall price change, one needs to take into account not only the components' price changes, but also the appropriate weights (see Section 7.4.4.3 for an example). This is more complex than it may seem at first sight. Frequently, at the levels of disaggregation found within a tariff, no weights would be available at the component level. Such a tariff would be likely to fall within an elementary aggregate, where weights are normally unavailable. In most cases of tariff pricing, the only source of weights is the product supplier, such as an electricity provider. For some utilities, national regulators may also be able to supply weights data.

For some products, consumption expenditure on tariff components may possibly be derived from standard sources such as household budget surveys. However, the measurement of tariff component expenditures may be too demanding to include in the Household Budget Survey (HBS) questionnaires and diaries, which may already impose quite a heavy respondent burden. Rather, as noted above, it is often necessary to use data directly from the tariff suppliers; Regulation (EU) 2016/792 Article 5(3) imposes several obligations on suppliers.

For example, telephone operators typically have a detailed knowledge of the use of the services they provide, as they need this information when billing for their services. If data protection and confidentiality issues can be resolved, companies may be able to provide weighting data without imposing a significant response burden on their own internal accounting systems.

For public-sector services, the value and structure of tariff-based expenditures can often be derived from the relevant organisations' accounting systems. Authorities with regulatory functions, particularly for utilities, may be a useful source of information, as they also collect a large amount of information on price and volume to carry out their own functions. An example is a government agency responsible for issuing motor vehicle licences, the price of which may depend on factors including the age of the vehicle, its engine size and so on.

For tariffs, weights for the tariff elements may be based on either prices or quantities. If *prices* are averaged, then the weights should be their relative *quantities*; if *indices* are averaged, then the weights are *expenditures* on each tariff element. However, both approaches produce a Laspeyres index.

7.4.4.6　Quality adjustment

A tariff-based service may be supplied by a mobile phone network, and the geographic coverage of the network may be a relevant quality factor. The quality of the network, in terms of physical coverage, would ideally be consistent over the index period. In practice, changes in the coverage of networks do occur. Given the complex nature of such networks, it is usually not possible to quality adjust for such changes, and it should be accepted that this may result in some inaccuracy in the HICP. In some tariff-priced markets new tariff components are frequently introduced (e.g. multimedia messages or email on mobile phones). They should be introduced into pricing schemes or consumer profiles by resampling and chaining as they gain significant market share. At the very least, as part of the regular annual update of the HICP, the tariff structures or consumer profiles priced should be reviewed and

resampled as required to make sure they remain representative. Such new components may pose special problems when they are available only as part of a more general package.

For general guidance on quality adjustment methods, see Chapter 6. As regards quality adjustment in tariff prices, when there are simultaneous changes in several parts of the tariff, as often happens — the matched pairs approach does not account for the joint effect of such changes. In practice, in the matched pairs approach with detailed definitions, the quality change situation always occurs in the form of a disappearing product offer, i.e. some pre-specified component of the tariff is no longer available for pricing. In principle, the treatment is the same as for other goods and services in the HICP. A replacement should be selected for the disappearing component: if the replacement is not comparable, it should be made essentially equivalent via quality adjustment. Quality adjustment of tariffs in the telecommunications sector is discussed in detail in Section 12.6.

7.4.4.7   New service providers and new products

In most product areas of the HICP, the outlet dimension is thought of as an element of the quality of the products, so it is kept fixed over the index period. In practice, emerging new outlets are chained into the index (normally with the updating of weights in December each year), thus assuring that they are differentiated from the existing outlets; only in rare cases is direct comparison or an explicit quality adjustment made. The underlying assumption may be that, in addition to the possible differences in the assortment, the location itself is a key quality factor.

When it comes to tariff-priced services the situation is somewhat different. Tariff-based services are often delivered on the spot (like mobile telephone services) or at the consumer's home (e.g. electricity, fixed-line telephone services). From the consumer's point of view, many tariff-priced services are relatively uniform. Electricity delivered to the consumer is homogeneous almost by definition; if not, it would be unusable.

The same may hold true for other services, like telephone services or internet services, despite providers' attempts to differentiate their products and make their pricing structures more and more opaque. Suppliers of tariff-priced services should therefore be considered as providing the same type of service and treated as substitutes for each other where replacement suppliers are required. Changes in the market mix of a clearly homogeneous product with different tariff structures and suppliers should be incorporated in the index as part of the annual basket review process.

Index construction therefore requires the following:

- Information must be provided/obtained at frequent intervals about the market share of different providers and the various tariff/service plans;

- Significant new service providers should be included in the index during annual resampling.

7.4.4.8   Examples of changes in the specification of tariffs

a) Example of direct comparison: changes in tariff components

Public transport within a city where a tariff component changes: bus fare from city centre to suburb A, at 2 a.m. on a Saturday (night tariff, last connection).

Changed component: bus fare from city centre to suburb A, at 1.30 a.m. on a Saturday (night tariff, last connection).

The basis for direct comparison is the index compiler's judgement that from the consumer's point of view the change in timing is not a significant change. It could also be argued that the quality of the service has deteriorated, as the last connection is now earlier in the morning, and the index should reflect that. The decision to make a direct comparison is always a matter of judgement to some extent and should therefore be based on explicit reasoning.

b) The introduction of a new tariff component

Table 7.4.4 illustrates this case. A cinema tariff has two components: *adults* and *children*. A new category of *teenagers* is introduced. In this example, the old tariff structure had two categories (children and adults), while the new one has three (teenagers, in between children and adults). The previous categories have to be transformed into the new ones. Using the best information available, it was concluded that the consumption shares are as indicated in Table

7.4.4 below. It is then possible to calculate the weighted average price of the ticket for both periods and compare the results to obtain the price relative. The weights shown represent the percentages of each type of customer.

Table 7.4.4: Cinema tickets, the introduction of a new tariff component

Old tariff	Weight %	Price	New tariff	Weight %	Price
Children 5-16	40	€5	Children 5-12	20	€5
			Teenagers 13-18	40	€8
Adults 17+	60	€10	Adults 19+	40	€10

The result in this case shows an overall price increase of 2.5 %:

$[(0.2 \times 5) + (0.4 \times 8) + (0.4 \times 10)] / [(0.4 \times 5) + (0.6 \times 10)] = 8.20 / 8.00$

This is an example of the application of Article 5(2) of Regulation No 2646/98 (see Section 7.4.2).

7.5 Zero prices

7.5.1 Introduction

Sometimes, products (i.e. goods or services) that have previously been free of charge at the point of provision can become chargeable. Conversely, products that once attracted a charge may become free at the point of provision. The change from zero to non-zero prices and vice versa can occur at the level of the elementary aggregate, at an ECOICOP category level, or at a sub-elementary aggregate level.

Examples of zero prices becoming positive prices for services are:

- introducing fees for certain health services,
- university tuition fees,
- parking charges.

Examples involving goods are:

- school textbooks,
- medicines,
- medical equipment,
- hospital meals,
- domestic water supply.

Examples of positive prices falling to zero include the abolition of television licences in the Netherlands and the abolition of university tuition fees in Germany. Inevitably, most examples of such changes involve products in the public sector.

The precise algebraic treatment depends on whether the price moves from zero to positive or from positive to zero, and on whether the product is:

a. at the level of the elementary aggregate,

b. at an ECOICOP category level, or

c. at a sub-elementary aggregate level.

These cases are dealt with in turn.

a, b) Products at the level of the elementary aggregate or at an ECOICOP category level

The problem for the HICP compiler when prices move from zero to a positive price is twofold [53].

1.	The weight, price-updated to the price reference period, is zero.

2.	There is no price reference period price with which to compare the new price to create a price relative.

For a Laspeyres-type index such as the HICP, this raises a conceptual problem; if both the weight and the price of a certain product were zero, it could be argued that it should not be included in the price reference period at all. And, indeed, if it remained zero through the year up until the next chain-linking, it would rightly be ignored. But if, during that period, the zero price becomes a positive price, then under any normal definition of inflation such an increase should be covered.

Another way of looking at this is to argue that the product has in principle been included in the index all the time, with positive quantities but zero prices.

It is noteworthy that there is a difference between the appearance on the market of a price for a product previously provided free and the appearance on the market of a newly significant product. In the first of these two cases, the product itself has always been available and consumed. In the second, the product itself is new (or newly significant).

The change from a positive to a zero price does not generally involve the same difficulties as the reverse process.

c) Products at a sub-elementary aggregate level

One of the difficulties in dealing with a newly chargeable product and a product whose price has fallen to zero is that the Jevons formula cannot handle a zero price. This is because Jevons requires a geometric mean of a set of prices: if one of those prices is zero, a geometric mean cannot be calculated. The Dutot formula avoids this problem.

## 7.5.2	Legal framework

Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices, Article 2a(6) principles, states:

> *'6. Where goods and services have been available to consumers free of charge, and subsequently an actual price is charged, then the change from a zero price to the actual price, and vice versa, shall be taken into account in the HICP.'*

This basic rule covers the essential reasons for dealing with the situation when a previously free product becomes chargeable, or vice versa. Article 8 of Regulation No 1749/96 concerns sampling in general; Article 2a(6) of this Regulation simply states that the sample of price changes must include, in principle, all price changes — implying that changes from zero to positive and vice versa must also be covered.

## 7.5.3	Typology of cases

Table 7.5.1 below gives the typology of cases discussed in this section.

[53]	Practical Guide to Producing Consumer Price Indices; paragraph 8.35.

Table 7.5.1: Typology of cases

Case	Price moves from zero to positive	Price moves from positive to zero
Level of the elementary aggregate	The exact solution comes from the fixed basket interpretation of the Laspeyres index. For the implementation, an estimate of the quantity is needed.	Since the zero sub-index multiplied by the positive weight gives a well-defined zero contribution, the price change is taken into account in the HICP.
ECOICOP category level	The exact solution comes from the fixed basket interpretation of the Laspeyres index. For the implementation, an estimate of the quantity is needed. Plus an additional convention: only the weight of the higher-level ECOICOP category is redistributed, while the rest of the weights matrix remains unchanged. The implied sub-indices are then derived backwards. However, publication and dissemination remain open issues. Member States should therefore contact Eurostat in this case.	Since the zero sub-index multiplied by the positive weight gives a well-defined zero contribution, the price change is taken into account in the HICP.
Sub-elementary aggregate level ([54])	If the Jevons index is used, the solution is to find or estimate the quantity, i.e. the problem is treated in the same manner as at the level of the elementary aggregate.	If the Jevons index is used, the solution is to find or estimate the weight, i.e. the problem is treated in the same manner as at the level of the elementary aggregate.

7.5.4 Methods for treating products previously provided free

The analytic solution is to use the standard Laspeyres index formula, but to replace expenditure weights by quantities and using price *levels* rather than price *relatives*.

The precise formulation may need to be adapted slightly, depending on the classification level of the new product concerned (see a) to c) in Section 7.5.1). These three cases are dealt with below.

a) Products at the level of the elementary aggregate

The product subject to the new charge can be treated as if it were already included with a zero price but with non-zero quantity corresponding to its estimated consumption in the price reference period.

The *Practical Guide to Producing Consumer Price Indices* (paragraph 8.36) gives the solution as follows, where the **N**th price was zero in the price reference period

$(p_N^{0t} = w_N^{0t,t-1} = 0)$: [55]

$$P_L^{0t,mt} = \frac{\sum_{i=1}^{N} p_i^{mt} \cdot q_i^{t-1}}{\sum_{i=1}^{N} p_i^{0t} \cdot q_i^{t-1}} = \sum_{i=1}^{N-1} \frac{p_i^{mt}}{p_i^{0t}} \cdot w_i^{0t,t-1} + \frac{p_N^{mt} \cdot q_N^{t-1}}{\sum_{i=1}^{N-1} p_i^{0t} \cdot q_i^{t-1}} \qquad (7.5.1)$$

Given that q_N^{t-1} is generally not known, the expression $p_N^{mt} \cdot q_N^{t-1}$ can be replaced, if there are no marked changes in quantities due to the new charge, by the estimated total expenditure on the product now subject to the new charge in period mt:

$$p_N^{mt} \cdot q_N^{t-1} = \frac{p_N^{mt} \cdot q_N^{mt}}{q_N^{mt}/q_N^{t-1}} \approx p_N^{mt} \cdot q_N^{mt} \Longleftrightarrow q_N^{t-1} \approx q_N^{mt} \qquad (7.5.2)$$

[54] Special care should be taken to check whether the results are meaningful. The introduction of quantities and weights, respectively, can yield indices that do not properly reflect the observed price change. A simple test would be to check whether the numbers derived are higher if prices move from zero to positive (or lower if prices move from positive to zero) than would be the case if, counterfactually, no price change had been assumed. Neither the retrospective introduction of quantities/weights, i.e. revision of the series, nor chain-linking are recommended.

[55] This formulation is adapted from the exposition in the Practical Guide.

The method is simple in principle, though there may be some difficulties in estimating the appropriate data and validating the assumption of unchanged quantities.

Example of a product moving from zero to a positive price: entering Antwerp with a car (elementary aggregate index level)

Since 1 February 2017, the entire city centre of Antwerp and part of Linkeroever in Belgium are a low emission zone. Only cars that fulfil the conditions for admission may still enter the city freely. Some vehicles are prohibited while others may enter only after purchasing a permit. The price for a permit depends on the vehicle's size. The regular tariff for a passenger car is EUR 350 per year.

According to the figures, about 8 000 owners of a passenger car would have to pay. The experience in Rotterdam, a city nearby in the Netherlands, where a similar measure has been introduced in 2016, showed that 2 % of the cars were too old and polluting and that this number dropped to 0.1 % after the introduction. Taking into account that people adapt and applying the same reduction, there are still 400 cars left [56]. Assuming that the owners take the annual fee of EUR 350 this gives a total of EUR 140 000.

That amount has been added to ECOICOP 07.2.4.2, toll facilities and parking meters. The December expenditure of this sub-class has been EUR 113 400 000. Since the new rule was not enforced in February, it has been introduced in the HICP in March, only. The effect at the ECOICOP category level has been

$$\frac{140\ 000}{113\ 400\ 000} \cdot 100 = 0.12.$$

Indeed, the published index level was 103.00 in December 2016 and has been 103.12 since March 2017.

b) Products at the ECOICOP category level

Treatment at this level is essentially the same as that at the elementary aggregate level. This rationale is applied to the higher-level ECOICOP index so that at this level there are now only positive sub-indices and weights, which should thus remain unchanged. In a first step, based on this solution, only the weight of the higher-level ECOICOP category is redistributed, reflecting the price-updated observed expenditures and estimated hybrid expenditures; the rest of the weights matrix remains unchanged. Then, the implied sub-indices are derived backwards. However, publication and dissemination of these ECOICOP indices remain open issues, and Member States should first consult Eurostat (see Chapter 10 — Revisions and handling of methodological changes).

c) Products at a sub-elementary aggregate level

Weights at this level are generally unknown. If the Jevons index is used, the solution is to find or estimate a quantity/weight. The problem is thus treated in the same manner as at the level of the elementary aggregate.

7.5.5   Prices falling to zero

The expression *zero prices* may not always refer to prices being charged for a product which was previously free of charge. The process can work in the opposite direction too; a product which used to have a price can be supplied free of charge. Section 7.5.1 gives some examples. However, a change from a positive to a zero price does not involve the same difficulties as the reverse process. Using the same categorisation as before, the calculations would be as follows:

a) Products at the level of the elementary aggregate

The elementary aggregate concerned would have a positive weight but a zero price relative, and the price change would thus be reflected in the overall index.

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[56]   This number is just the result of applying the *rule of three* to the above data. It should be noted that Belgium not only used evidence from the Netherlands in their assessment of the effect but particularly that only those cars (400) are included that are expected to be paid for after the introduction, although analytically the quantity from before the introduction (8 000) should be incorporated. That practice, however, would have led to a considerable overestimation of the actual effect (20-fold).

b) Products at the ECOICOP category level

In this situation, the ECOICOP category concerned would again have a positive weight and the price change would thus be reflected in the overall index.

c) Products at a sub-elementary aggregate level

Since weights at this level are generally unknown, the treatment of this case — if the Jevons index is used — is very much the same as that of the case when a price moves from zero to positive. That means the solution is to find or estimate a quantity/weight, thus the problem is treated in the same manner as at the level of the elementary aggregate.

7.6 Bundles

7.6.1 Introduction

A form of selling which has some similarities to tariffs (see Section 7.4) is that known as *bundling*. The formal definition is given below (Section 7.6.3). In brief, a bundle is a product offer comprising different components (goods and/or services). The components are not sold separately in this particular type of product offer, although they may be available separately as a set of individual product offers.

The essential problem with bundles is the definition of the *product*. There are several components in a typical bundle which could also be sold separately, and each component could have its own price index. Such components may already exist within an HICP. But the consumer (and the Member State itself) may have no means of identifying the prices and quantities within a bundle. Moreover, the consumer may not be interested in individual components; the attraction of a bundle may lie in the very fact that it is a bundle, not in its individual components.

A typical example is a package holiday, which comprises travel and accommodation, and may also include meals, guided tours and entertainment, sold at an all-inclusive price, which can often be less than the total price of purchasing the components separately. A key difference between a tariff and a bundle is that a tariff is a set of sales conditions for a single product, such as a bus fare or entry to a museum, while a bundle is a set of related objects sold together. Separate prices for the components may or may not exist. For example, the components bundled together in a package holiday cannot normally be specified and priced separately.

Another example of a bundle is a mobile phone package, which may include the handset, calls, SMS and internet data usage allowances. Services may also be bundled with goods, such as with repair warranties for vehicles or heating systems.

The way bundles are dealt with in the HICP is essentially determined by practical considerations and is necessarily arbitrary to some extent. For certain types of economic analysis, it is useful to be able to treat the different components separately, and to assign them to their appropriate ECOICOP headings, even if they are only estimates. For the analysis of consumer behaviour, however, it is also necessary to treat expenditure on bundles as if they were indeed combined product-offers. A consumer does not necessarily need to be able to disentangle the price components of a package holiday to determine which holiday offers the best value.

7.6.2 Legal framework and HICP Recommendations

Although the problem of dealing with bundles has been discussed in various fora over the years and is, for instance, included in the ILO CPI Manual, there are no legal acts requiring Member States to treat bundles in any particular way. However, there are HICP Guidelines issued by Eurostat on the subject 'Treatment of bundles/packages in COICOP/HICP — Guidelines note (June 2010) [57]. This section of Chapter 7 is based on Section 3 of these Guidelines, the relevant parts contain the following information:

[57]   Compendium of HICP reference documents, 2013 (Eurostat) p. 118-119.

- Bundles should be classified by the purpose for which the main component is intended to be used by the consumer;

- Where the package price is itemised and can readily be divided among the constituent components, the bundle may be split on the condition that component weights can be estimated;

- Where the price is not itemised, but the expenditure can be split within the bundle so that component weights can be calculated for each component, the change in the bundle price may then be applied to each component weight for the compilation of the HICP, irrespective of the group or division to which each component is assigned.

In practice, this means:

- Bundles should be classified by the purpose for which the main component is intended to be used by the consumer. In cases where it is not possible to estimate the component weights, the entire bundle should be assigned to the main component category. This would usually be identified as the probable main intended use of the product;

- Where the price of the bundle can be divided into its individual components, the bundle may be split into separate ECOICOP categories, if component weights can be estimated. This is generally the most appropriate way to deal with bundles. However, it depends on the prices of the individual components being itemised, which is often not the case;

- Where the component prices are not itemised, but the expenditure can be split into component weights, the change in the bundle price may be applied to each component weight within the relevant ECOICOP sub-classes.

In Section 7.6.5, several common bundles are listed along with advice on how to deal with them, on the basis of the above information, and with the guidance given in ECOICOP regarding classification of expenditures.

7.6.3 Definitions

Bundling: a method of marketing that involves offering two or more goods and/or services that serve two or more different purposes as if they were a single product. Bundling usually enables consumers to spend less than they would have to if they purchased the component goods and/or services individually.

Pure bundling: offering a group of products which are available only as a bundle and are not sold separately, such as hospital in-patient services and mobile phone call plans.

Mixed bundle: a group of products which are sold both as bundles and as individual units, such as combined software packages and cable TV services.

Package: the same as *bundle*.

Tariff: see Section 7.4.3.

7.6.4 Examples of pure and mixed bundles

Bundling has become an important way of marketing both goods and services. The following list gives a range of examples, showing which of the three categories they are likely to fall into: pure, mixed or with their own ECOICOP category. As noted above, national charging practices do vary, so what might be classified as a pure bundle in one country may be a mixed bundle in another. The examples are thus only indicative.

Likely to be 'pure' (available only as a bundle)

Package holidays — include travel, board, lodging and maybe more.

Mobile phone subscriptions — packages with varying levels of usage of calls, SMS, data downloads, etc. (N.B. In some countries, the handset may also be included.)

Domestic gas/oil boiler maintenance — includes parts, maintenance and safety checks.

Set-price menus — special two or three-course restaurant meals at a set price.

TV channels — a typical TV subscription includes a choice of channel packages, e.g. including or excluding sports channels or films.

Likely to be 'mixed' (available both as a bundle or in separate units)

Rents — some rents cover not only the cost of housing, but also services such as water supply, sewerage and other utilities, which are not necessarily priced separately on the tenant's bills, though they are necessarily included as part of the rental package.

Insurance — combinations of such services as, car insurance and home insurance or health and travel insurance may be offered as a package at a cheaper price than separate purchases.

Ready meal deals — e.g. a meal for two persons for €15 provided by supermarkets in one or more boxes, sometimes including two or three courses and a bottle of wine, sold at a discount compared with separate purchases.

TV/broadband/phone — various options offered by telecoms companies. These *triple pay* services are often sold as a set of bundled options for a single monthly fee. In many cases, these bundles can be tailored to individual consumers' preferences (e.g. including sports or on-demand movie services). In many cases, the cost of each option within the bundle is advertised. Alternatively, if these services are sold as a *pure* bundle, then the expenditure and prices can be assigned to Bundled Telecommunications Services (ECOICOP 08.3.0.4).

Mobile phone handset combined with service subscription — if a separate charge is made for the handset, this is an example of a mixed bundle. If the handset is not separately itemised, this is an example of a pure bundle (see above).

Dual fuel — energy providers offer a combined tariff for electricity and gas, accompanied by a dual fuel discount.

Software — it is possible to purchase various Microsoft applications such as Word and Excel separately, or to buy a combined set as *Office,* at a discount.

Special ECOICOP categories for bundles [58]

Maintenance charges in multi-occupied dwellings — (ECOICOP 04.4.4.1), co-proprietor services charges for cleaning, lighting and heating and management of communal areas etc.

In-patient hospital stays — (ECOICOP 06.3.0.0 hospital services) which may include medical services, accommodation, catering etc.

Combined passenger transport — (ECOICOP 07.3.5.0); this may, for example, cover tickets for combined rail and bus or ferry journeys.

Bundled telecommunication services — (ECOICOP 08.3.0.4 telephone/internet/TV packages) should be classified here if they are sold as a pure bundle.

Package holidays — (ECOICOP 09.6).

7.6.5   Methods for treating bundles in the HICP

The treatment of bundled goods is a matter of concern for the HICP. This section provides some guidance aimed at harmonising the classification of bundled products.

Bundled products are generally required, if feasible in practice, to be separated and assigned to particular ECOICOP sub-classes or classes within the same or different ECOICOP groups or divisions. However, while ECOICOP shows awareness of the problem of bundling (see below), it does not normally provide clear guidance on the classification of bundled products. Exceptions, where there are specific ECOICOP categories for bundled products, include: package holidays (ECOICOP 09.6) and bundled telecommunication services such as fixed line, internet and TV subscription services (ECOICOP 08.3.0.4).

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[58]   This list is not necessarily comprehensive.

Member States may decide to classify similar types of bundle in different ways. It is therefore necessary to have harmonised methods for the HICP, to avoid the non-comparability that would arise if some Member States split bundles into separately classified components, while others classified bundles according to the purpose of their main component. However, it is recognised that national charging practices can and do vary between Member States, and it is therefore impossible for all of them to follow precisely the same procedures in all cases.

The Introduction to the original COICOP ([59]) (paragraphs 46-48) gives the following advice regarding bundles:

'Mixed purpose goods and services

Single outlays may sometimes comprise a bundle of goods and services that serve two or more different purposes. For example, the purchase of an all-inclusive package tour will include payments for transport, accommodation and catering services, while the purchase of educational services may include payments for health care, transport, accommodation, board, educational materials, etc.

Outlays covering two or more purposes are dealt with on a case-by-case basis with the aim of obtaining a purpose breakdown that is as precise as possible and consistent with practical considerations of data availability. Hence, purchases for package holidays are shown under Package holidays *with no attempt to isolate separate purposes such as transport, accommodation and catering. Payments for educational services, on the other hand, should be allocated as far as possible to* Education, Health, Transport, Restaurants and hotels *and* Recreation and culture.

Two other examples of mixed purpose items are: the purchase of in-patient hospital services which include payments for medical treatment, accommodation and catering; and the purchase of transport services which include meals and accommodation in the ticket price. In both cases, there is no attempt to isolate separate purposes. Purchases of in-patient hospital services are shown under Hospital services *and purchases of transport services with accommodation and catering are shown under* Transport services'.

ECOICOP, following the above precedent, was developed to address specifically some common types of bundle. As markets develop constantly, new bundles (such as those in streamed internet services) constantly appear, presenting challenges for index compilers.

It should be emphasised that the definition of the *main component* of a bundle is not always clear-cut. It may vary not only from country to country, but even from household to household, to the extent that different households are unlikely to attach the same importance to the various components of a bundle. This implies there is a need for clear advice on how to decide the main purpose of bundles. This is an area which will no doubt be further developed in HICP methodology.

An often overlooked aspect of bundle pricing is the question of quality adjustment. Generally, quality adjustment for services is an area which, given the conceptual and practical difficulties involved, is still not well developed. However, in principle, quality adjustment methods, such as hedonics and option pricing, may be applied in order to partition the bundle price or deal with changes in the characteristics or contents of a bundle (see Chapter 6).

7.6.6   Changes in bundle composition

From time to time the composition of a bundle can change. For example, within internet and TV subscriptions (an example of a mixed bundle), channels that once attracted a separate charge, such as movies, may now be included as part of the package. Mobile telephone call plans, with a set number of minutes or text messages, are an example of a pure bundle.

As with any other product in the HICP, when comparing prices the aim is always to compare on a like-with-like basis. Where a replacement product offer differs from the replaced product offer, an appropriate quality adjustment should be made. Take the first example of the addition of a movie channel to an internet and TV subscription bundle. If the cost of the movie channel as a separate service is known, an appropriate quality adjustment can be made to the cost of the bundle (see Chapter 6, which discusses various methods for quality adjustment and product replacement). In the second example of a change in the call or text message allowances within a pure bundle, quality adjustment is more problematic, as the individual components are not sold separately. Depending on the method used to price these types of bundle (tariff), a quality adjustment may or may not be necessary. See Section 7.4 and in particular Section 12.6, which discusses quality adjustment of telecommunications services.

([59])   Statistical Papers, Series M No 84, Department of Economic and Social Affairs, Statistics Division, United Nations, New York, 2000.

8

Index calculation

8.1 Introduction

This chapter details the minimum standards for index calculation methods [60] that are appropriate to fulfil the HICP legal framework. Generic mathematical formulas are given to express the principles and provide an unambiguous basis for their implementation in computer programming. The annex contains a numerical example illustrating the entire index theory covered in this chapter.

The chapter starts with the higher-level indices, defining the HICP as a *Laspeyres-type index* (Section 8.2). Statistically, the structure of household expenditures resembles an inverse tree, descending from the total to increasingly detailed aggregates. There is always a level below which no or insufficient information is available for a further breakdown. This is the level of the elementary aggregates discussed in Section 8.3.

Section 8.4 describes and explains annual chain-linking, i.e. constructing longer time series. Annual chain-linking has the advantage of allowing the weights, the sample of products and sample of outlets to be updated at each link, thus ensuring that the HICP is as representative of consumers' current expenditure patterns as possible. Section 8.5 covers the calculation of monthly and annual rates of change.

8.2 Higher-level indices

8.2.1 Legal obligations

Article 3(2) of Regulation (EU) 2016/792 provides that:

> The harmonised indices shall be annually chain-linked Laspeyres-type indices.

The latter term is defined in Article 2(14) as follows:

> 'Laspeyres-type index' means the price index that measures the average change in prices from the price reference period to a comparison period using expenditure shares from a period prior to the price reference period, and where the expenditure shares are adjusted to reflect the prices of the price reference period.

> A 'Laspeyres-type index' is defined as:

$$P^{0,t} = \sum \frac{p^t}{p^0} \cdot w^{0,b}.$$

> The price of a product is denoted by *p*, the price reference period is denoted by 0, and the comparison period is denoted by *t*. Weights (*w*) are expenditure shares of a period (*b*) prior to the price reference period, and are adjusted to reflect the prices of the price reference period 0.

Further, the following other definitions also apply:

- The price reference period (0) 'means the period to which the price of the comparison period is compared; for monthly indices, the price reference period is December of the previous year' (Article 2(16) of Regulation (EU) 2016/792);

- The comparison period (*t*) means the period for which the index is calculated; and

- The weight reference period (*b*) means the previous calendar year [61].

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[60] For discussions of alternatives and the reasons for the choices made, see the specialist literature, such as ILO, IMF, OECD, UNECE, Eurostat, and The World Bank (2004), *Consumer Price Index Manual: Theory and Practice*, International Labour Office; v.d. Lippe, P.M. (2001), *Chain Indices: A Study in Price Index Theory*, Metzler-Poeschel; v.d. Lippe, P.M. (2007), *Index Theory and Price Statistics*, Lang; Balk, B.M. (2008), *Price and Quantity Index Numbers: Models for Measuring Aggregate Change and Difference*, Cambridge University Press. Ralph, J., O'Neill, R., and Winton, J. (2015), *A Practical Introduction to Index Numbers*, Wiley provide a non-specialist introduction.

[61] This is what is meant by 'period prior to the price reference period' in Article 2(14) of Regulation (EU) 2016/792. For a discussion of this vagueness see Section 8.2.2.

8.2.2 The HICP concept

Conceptually, an HICP at any ECOICOP level is designed as a Laspeyres-type index. What does this mean?

Consider a set of N products with prices p_i^τ and quantities q_i^τ $(i = 1, \ldots, N)$ for any time period τ. The *short-term* [62] Laspeyres index *with annual weights* [63] for month $m = 1, \ldots, 12$ of current year t, mt being the comparison period, relative to December of the preceding year $t-1$, which is the price reference period [64], is given by [65]

$$P_L^{0t,mt} = \frac{\sum_{i=1}^N p_i^{mt} \cdot q_i^{t-1}}{\sum_{i=1}^N p_i^{0t} \cdot q_i^{t-1}} = \sum_{i=1}^N \frac{p_i^{mt}}{p_i^{0t}} \cdot \frac{p_i^{0t} \cdot q_i^{t-1}}{\sum_{j=1}^N p_j^{0t} \cdot q_j^{t-1}} \tag{8.1}$$

where year $t-1$ is the weight reference period [66].

It is important to note that in the construction of the HICP, the month of December plays a dual role: it is sometimes used as a comparison period, but is always the price reference period. To distinguish clearly between these two roles and to avoid complications, we use the notation in equation (8.1). Thus, December in year t (occurring in the numerator of equation (8.1)) is labelled as $m = 12$, whereas December in year $t-1$ (occurring in the denominator of equation (8.1)) is labelled as month $m = 0$ of year t. In other words, each year t is considered as consisting of 13 months, running from December of year $t-1$ ($0t$) to December of year t ($12t$).

The weight reference period, used to compute the price indices for all the months of year t, is only vaguely defined in Regulation (EU) No 1114/2010. Article 2(1) refers to the 'period … from which the weights are estimated'. Article 3(1), on the other hand, sets straight that the weight reference period is the year $t-1$, as this is the most recent calendar year. Thus, though following Article 3(2) the year before the previous calendar year is in general the weights data *source period*, this should not be mistaken for the target weight *reference period*. However, the year $t-1$ expenditure shares are usually not yet available with sufficient accuracy early in year t when they are required for the first index number computation.

Article 3 of Regulation (EU) No 1114/2010 requires that:

(1) … Member States shall produce HICPs using sub-index weights which reflect the consumers' expenditure pattern in the weighting reference period and aim to be as representative as possible for consumers' expenditure patterns in the previous calendar year.

(2) … Member States shall therefore review and update HICP sub-index weights taking into account preliminary national accounts data on consumption patterns of year $t-2$…

(3) Member States shall review annually whether or not there have been any important and sustained market developments affecting quantities in the sub-divisions of COICOP/HICP, between [period $t-2$] and period $t-1$, in order to estimate weights that are as up-to-date as possible …

(4) … HICP weights shall … be price-updated to prices of the preceding December.

Therefore, the usual strategy (see Chapter 3) is to:

1. make a best estimate of consumers' expenditure patterns in the *weight reference period* year $t-1$ on the basis of preliminary national accounts data on consumption patterns in year $t-2$; and

2. execute price-updating reflecting the prices of the *price reference period* $0t$ (December of the year $t-1$).

The weights derived in this way are denoted by $w_i^{0t,t-1}$. Then, the Laspeyres-type index can be written as a weighted arithmetic mean of price relatives of products:

$$P^{0t,mt} = \sum_{i=1}^N \frac{p_i^{mt}}{p_i^{0t}} \cdot w_i^{0t,t-1} \tag{8.2}$$

[62] *Short-term* here denotes the index relative to the price reference period rather than a month-on-month index.

[63] It is because of the use of annual weights for a monthly index that this exposition deviates from the standard textbook definition of the Laspeyres (price) index.

[64] In this chapter, denoted as month 0 of year t.

[65] For reasons of presentation, the index numbers are usually multiplied by 100.

[66] In Regulation (EU) 2016/792, the price reference period $0t$ is labelled '0', the comparison mt is labelled 't' and the weight reference period $t-1$ is labelled 'b'.

with weights adding up to unity. Thus, the difference between the Laspeyres index of equation (8.1) and the Laspeyres-type index of equation (8.2) lies in the weights.

Equation (8.2) corresponds to the equation in Article 2(14) of Regulation (EU) 2016/792. The target is to compare the prices of the current month to those of the price reference period, which is December of the previous year, based on annual expenditure weights from the previous calendar year price-updated to the price reference period. Below we address the question of which estimate of the weights in the weight reference period should be used for a Laspeyres-type index.

8.2.3 Deriving the weights

The weights $w_i^{0t,t-1}$ do not correspond to observable expenditure shares, as they depend on prices from the price reference period and quantities from a period prior to the price reference period. They are called mixed-period weights. They can be derived from the observed (67) annual expenditures shares of year $t-2$

$$v_i^{t-2} = \frac{\left(p_i^{t-2} \cdot q_i^{t-2}\right)}{\sum_{j=1}^{N}\left(p_j^{t-2} \cdot q_j^{t-2}\right)} \tag{8.3}$$

in two ways.

Option 1 simply uses v_i^{t-2} as the best approximation for the true, but unknown weight w_i^{t-1}:

$$w_i^{t-1} := v_i^{t-2} = \frac{\left(p_i^{t-2} \cdot q_i^{t-2}\right)}{\sum_{j=1}^{N}\left(p_j^{t-2} \cdot q_j^{t-2}\right)} \tag{8.3a}$$

In option 2, the expenditure shares are inflated (68) by the price change between year $t-2$ and year $t-1$:

$$w_i^{t-1} := \frac{v_i^{t-2} \cdot \frac{p_i^{t-1}}{p_i^{t-2}}}{\sum_{j=1}^{N} v_j^{t-2} \cdot \frac{p_j^{t-1}}{p_j^{t-2}}} = \frac{\left(p_i^{t-1} \cdot q_i^{t-2}\right)}{\sum_{j=1}^{N}\left(p_j^{t-1} \cdot q_j^{t-2}\right)} \tag{8.3b}$$

If goods and services are substitutes at such a rate that expenditure on one product relative to another is independent of the relative prices (Cobb-Douglas preferences), option 1 is the preferred approach. If goods and services are perfect complements, i.e. there is no substitutability between them and they are consumed in fixed proportions (Leontief preferences), the best approximation is the price-updated weight of option 2. Of course, the degree of substitutability may vary across products and the choice of either of the two options is not necessarily straightforward (69).

On this basis, price-updating of the weights to December $t-1$ (the price reference period) should be carried out as follows (70):

$$w_i^{0t,t-1} = \frac{w_i^{t-1} \cdot \frac{p_i^{0t}}{p_i^{t-1}}}{\sum_{j=1}^{N} w_j^{t-1} \cdot \frac{p_j^{0t}}{p_j^{t-1}}} \tag{8.4}$$

where the (theoretical) expression using prices and quantities depends on whether equation (8.3a) or equation (8.3b) is used to estimate w_i^{t-1}. If the expression based on equation (8.3a) is substituted in equation (8.2), the resulting formula is known as the Young index (71). Equation (8.3b), on the other hand, yields the Lowe index.

---

(67) The brackets indicate that only the product of (price × quantity) can be observed, but neither prices nor quantities separately.

(68) This option should not be confused with the price-update to the price reference period.

(69) We can evaluate retrospectively which of the two options performs better in practice by comparing the outcomes with that from using actual expenditures shares (available later).

(70) In practice, price-updating may be executed at a higher aggregation level, involving indices rather than individual prices.

(71) Under *homogeneous* Cobb-Douglas preferences, the Young index coincides with the Laspeyres index because expenditure shares remain constant. However, it should be borne in mind that the HICP is designed to assess price stability and is not intended to be a cost of living index (see recital (12) of Regulation (EU) 2016/792).

When the correlation between expenditures and relative prices is negative, as is usually the case, the Lowe index will tend to exceed the Laspeyres index. However, it is more difficult to generalise about the relationship between the Young index and the Laspeyres index. The Young may be greater or less than the Laspeyres, depending on how sensitive the expenditures are to changes in relative prices.

8.2.4   Consistency in aggregation

A feature of the Laspeyres-type index is its *consistency in aggregation*. Suppose that the set of all products N is divided into mutually disjoint subsets N_h $(h = 1, \dots, H)$. Then, the following is true:

$$P^{0t,mt} = \sum_{h=1}^{H} \left(\sum_{i_h=1}^{N_h} \frac{p_{i_h}^{mt}}{p_{i_h}^{0t}} \cdot \frac{w_{i_h}^{0t,t-1}}{\sum_{j_h=1}^{N_h} w_{j_h}^{0t,t-1}} \right) \cdot \left(\sum_{i_h=1}^{N_h} w_{i_h}^{0t,t-1} \right) = \sum_{h=1}^{H} P_h^{0t,mt} \cdot w_h^{0t,t-1} \tag{8.5}$$

Thus, the overall Laspeyres-type index is a weighted arithmetic mean of the Laspeyres-type indices for the subsets of products, defined as:

$$P_h^{0t,mt} = \sum_{i_h=1}^{N_h} \frac{p_{i_h}^{mt}}{p_{i_h}^{0t}} \cdot \frac{w_{i_h}^{0t,t-1}}{\sum_{j_h=1}^{N_h} w_{j_h}^{0t,t-1}} \tag{8.6}$$

The weights

$$w_h^{0t,t-1} = \sum_{i_h=1}^{N_h} w_{i_h}^{0t,t-1} \tag{8.7}$$

are the mixed-period expenditure shares of the *subsets*. In other words, the overall Laspeyres-type index can be calculated in one stage, from the product price relatives (as in equation (8.2)), or in two stages (as in equation (8.5)), from product price relatives to subset Laspeyres-type indices and then from these subset indices to the overall index. For statistical practice this is a very useful feature.

The geographical aggregation to the euro area and European Union works in the same way, with h then denoting Member States rather than subsets of products (see Chapter 11).

8.2.5   Higher-level compilation

In practice, the higher-level index compilation is based on product categories at ECOICOP and lower levels (elementary product groups and elementary aggregates). Correspondingly, price relatives are replaced by price indices for these categories ('sub-indices'). It is clear from equations (8.2) and (8.4) that quantity data are not required. What is needed are estimates of the expenditure shares for the weight reference period, sub-indices for price-updating those shares and sub-indices for the comparison month relative to the price reference period. The indices allowed for elementary aggregation are covered in Section 8.3.

8.3   Indices for elementary aggregates

8.3.1   Legal obligations

Article 7 of Regulation (EC) No 1749/96 provides that:

> HICPs shall be compiled using either of the two formulae given in paragraph 1 of Annex II to this Regulation or an alternative comparable formula which does not result in an index which differs systematically from an index compiled by either of the given formulae by more than one tenth of one percentage point on average over one year against the previous year.

Said Annex II defines the formulas to be used in compiling elementary aggregates [72]:

1. When compiling price indices for elementary aggregates either the ratio of arithmetic mean prices

$$\frac{\frac{1}{N}\Sigma p^t}{\frac{1}{N}\Sigma p^0}$$

or the ratio of geometric mean prices

$$\frac{(\Pi p^t)^{\frac{1}{N}}}{(\Pi p^0)^{\frac{1}{N}}}$$

where p^t is the current price, p^0 the reference price and N the number of such prices in the elementary aggregate, shall be used. An alternative formula may be used provided that it fulfils the comparability requirement laid down in Article 7.

2. The arithmetic mean of price relatives

$$\frac{1}{N}\sum\frac{p^t}{p^0}$$

should not normally be used, as it will in many circumstances result in failure to meet the comparability requirement. It may be used exceptionally where it can be shown not to fail the comparability requirement.

The Regulation provides that the arithmetic mean of price relatives is not to be used where chaining is more frequent than annual. There are good reasons for the *de facto* ban on this index in paragraph 2 above (comparability requirement): the underlying phenomenon is that it does not satisfy the circularity (transitivity) test [73]. This failing implies an indefinite bias, which in practice may show up as chain drift [74]:

$$\left(\frac{1}{N}\sum\frac{p^2}{p^0}\right) - \left(\frac{1}{N}\sum\frac{p^1}{p^0}\right)\cdot\left(\frac{1}{N}\sum\frac{p^2}{p^1}\right) = \mathrm{Cov}\left[\frac{p^1}{p^0},\frac{p^2}{p^1}\right] \tag{8.8}$$

8.3.2 Index theory and practice

Usually, each five-digit ECOICOP expenditure category is built up from subsets ('elementary product groups') and these in turn are built up from elementary aggregates.

Thus, in practice, HICPs are constructed in two stages:

- a first stage at the lowest level of aggregation, where we have only price information, but not associated expenditure information for weighting purposes; and

- a second stage of aggregation, where expenditure information for weighting purposes is available for higher levels of aggregation.

The aggregates that pertain to the first stage of aggregation are called *elementary aggregates*. Article 2 of Regulation (EC) No 1749/96 provides the following definitions:

13. An 'elementary product group' means a set of product-offers that are sampled in order to represent one or more consumption segments in the HICP. [75]

---

[72] Note that the notation in this quote is adapted to fit that used in Regulation (EU) 2016/792.

[73] The test requires that the chain-linked index (i.e. the product of the short-term index from period 0 to 1 times the short-term index from period 1 to 2) should equal the direct index comparing the prices in period 2 with those in period 0.

[74] This bias would only be definitely upward, i.e. the chain-linked index greater than the direct index and the covariance negative, if $p^2 = p^0$. However, this claim in the literature uses the special case of the so-called time reversal test as an argument, which is known as the country reversal test in interspatial comparisons.

[75] See Chapter 4.

14. An 'elementary aggregate' means an elementary product group stratified, for instance by regions, cities or outlet types and so refers to the level at which observed prices enter the HICP. Where elementary product groups are not stratified, the terms 'elementary product group' and 'elementary aggregate' shall have the same meaning.

15. An 'elementary aggregate index' means a price index for an elementary aggregate.

Two-stage aggregation involves losing consistency in aggregation between stages 1 and 2, as a Laspeyres-type index cannot be calculated at the lower level (stage 1). For stage 1 of the aggregation process, elementary aggregate indices $P_i^{0t,mt}$ are used instead:

$$P^{0t,mt} = \sum_{i=1}^{N} P_i^{0t,mt} \cdot w_i^{0t,t-1} \tag{8.9}$$

In the rest of this chapter, $i = 1, \dots, N$ denotes elementary aggregates rather than individual products.

Although (due to new and disappearing products) the set of products available for sampling generally varies from month to month, for the ease of exposition the presentation here is restricted to matched-model indices, i.e. it is assumed that there are no missing observations and no changes in the quality of the products sampled so that the sets of prices are perfectly matched.

Thus, consider an elementary aggregate with a set of K common products in any given time period. Many formulas have been proposed in the literature for measuring the price change of an elementary aggregate; the Dutot and Jevons indices are preferred.

Dutot index (ratio of arithmetic mean prices)

$$P_D^{0t,mt} = \frac{\frac{1}{K}\sum_{k=1}^{K} p_k^{mt}}{\frac{1}{K}\sum_{k=1}^{K} p_k^{0t}} \tag{8.10}$$

Jevons index (ratio of geometric mean prices, or geometric mean of price relatives)

$$P_J^{0t,mt} = \frac{\left(\prod_{k=1}^{K} p_k^{mt}\right)^{\frac{1}{K}}}{\left(\prod_{k=1}^{K} p_k^{0t}\right)^{\frac{1}{K}}} \tag{8.11}$$

$$= \left(\prod_{k=1}^{K} \frac{p_k^{mt}}{p_k^{0t}}\right)^{\frac{1}{K}}$$

Carli index (arithmetic mean of price relatives)

$$P_C^{0t,mt} = \frac{1}{K}\sum_{k=1}^{K} \frac{p_k^{mt}}{p_k^{0t}} \tag{8.12}$$

If the samples remain unchanged throughout the year, as is assumed here, the chain-linked Dutot and Jevons indices reduce to the respective direct indices. For example, using the ratio of arithmetic means [76]:

$$
\begin{aligned}
CP_D^{0t,mt} &= P_D^{0t,1t} \cdot P_D^{1t,2t} \cdot \dots \cdot P_D^{(m-1)t,mt} \\
&= \frac{\frac{1}{K}\sum_{k=1}^{K} p_k^{1t}}{\frac{1}{K}\sum_{k=1}^{K} p_k^{0t}} \cdot \frac{\frac{1}{K}\sum_{k=1}^{K} p_k^{2t}}{\frac{1}{K}\sum_{k=1}^{K} p_k^{1t}} \cdot \dots \cdot \frac{\frac{1}{K}\sum_{k=1}^{K} p_k^{mt}}{\frac{1}{K}\sum_{k=1}^{K} p_k^{(m-1)t}} = \frac{\frac{1}{K}\sum_{k=1}^{K} p_k^{mt}}{\frac{1}{K}\sum_{k=1}^{K} p_k^{0t}} = P_D^{0t,mt}
\end{aligned} \tag{8.13}
$$

$CP_D^{0t,mt}$ becomes the simple ratio of arithmetic means $P_D^{0t,mt}$ (or similarly with the geometric formula described above). Hence, the index for an elementary aggregate may be calculated as a chain-linked month-on-month index

---

[76] Where misunderstanding is possible, here and elsewhere in the text, months and years, such as $m-1$ or $t-1$, are put in brackets.

using one of the two preferred formulas. However, if the set of products available for sampling varies from month to month, using monthly chain-linking and replenishment is *not* a preferred method in many situations [77].

The chain-linked Carli index would provide the following elementary aggregate index:

$$CP_C^{0t,mt} = P_C^{0t,1t} \cdot P_C^{1t,2t} \cdot \ldots \cdot P_C^{(m-1)t,mt}$$

$$= \left(\frac{1}{K}\sum_{k=1}^{K}\frac{p_k^{1t}}{p_k^{0t}}\right) \cdot \left(\frac{1}{K}\sum_{k=1}^{K}\frac{p_k^{2t}}{p_k^{1t}}\right) \cdot \ldots \cdot \left(\frac{1}{K}\sum_{k=1}^{K}\frac{p_k^{mt}}{p_k^{(m-1)t}}\right) \neq \frac{1}{K}\sum_{k=1}^{K}\frac{p_k^{mt}}{p_k^{0t}} = P_C^{0t,mt} \tag{8.14}$$

$CP_C^{0t,mt}$ does *not* reduce to a direct Carli index $P_C^{0t,mt}$ if the samples do not change.

8.3.3 Compilation issues

Much research has gone into finding the best index for an elementary aggregate and quite a lot is known about the behaviour of the various proposals under various assumptions; however, only a few hard facts have been established. By expanding $P_J^{0t,mt}$ by a second-order Taylor series approximation around the arithmetic mean prices $p_k^{0t} = \bar{p}^{0t}$ and $p_k^{mt} = \bar{p}^{mt}$ for all $k = 1, \ldots, K$ (K being sufficiently large), we can verify that the difference between the Dutot and the Jevons indices depends on the change over time of the squared coefficient of variation of individual prices:

$$P_J^{0t,mt} \approx P_D^{0t,mt}\left(1 + \frac{1}{2}\frac{\mathrm{Var}[p_k^{0t}]}{(\mathrm{E}[p_k^{0t}])^2} - \frac{1}{2}\frac{\mathrm{Var}[p_k^{mt}]}{(\mathrm{E}[p_k^{mt}])^2}\right) \tag{8.15}$$

Likewise, by expanding $P_D^{0t,mt}$ around the geometric mean prices $\ln p_k^{0t} = \ln \bar{p}^{0t}$ and $\ln p_k^{mt} = \ln \bar{p}^{mt}$, we obtain the following second-order approximate relationship:

$$P_D^{0t,mt} \approx P_J^{0t,mt}\left(1 - \frac{1}{2}\mathrm{Var}[\ln p_k^{0t}] + \frac{1}{2}\mathrm{Var}[\ln p_k^{mt}]\right) \tag{8.16}$$

However, whether the difference between the Dutot and Jevons indices is positive or negative, large or small, is an empirical matter. Still, Silver and Heravi (2007, J. Econometrics) show that this difference depends on the change over time in price dispersion. Some of the price dispersion will be due to product heterogeneity.

The Dutot index has the drawback of tending primarily to reflect the price development of products at relatively high prices. This can be seen if we consider again equation (8.10):

$$P_D^{0t,mt} = \frac{\frac{1}{K}\sum_{k=1}^{K}p_k^{mt}}{\frac{1}{K}\sum_{k=1}^{K}p_k^{0t}} = \sum_{k=1}^{K}\frac{p_k^{mt}}{p_k^{0t}} \cdot \frac{p_k^{0t}}{\sum_{l=1}^{K}p_l^{0t}} \tag{8.10a}$$

It appears that the Dutot index can be written as a weighted arithmetic mean of individual price relatives, its weights being relative prices in the price reference period. In the Dutot index, products with higher relative prices get a higher weight and products with lower relative prices get a lower weight. Thus, it is advisable to use the Dutot index only for elementary aggregates in which the relative prices exhibit small variance, i.e. the price levels are similar.

A quick glance at the formula of the Jevons index (equation (8.11)) tells us that it is not a linear index. Nevertheless, the unique *linear* approximation to the Jevons index first described by Mehrhoff (2007), and independently devised by Balk (2008) as the unweighted Walsh index, yields what is referred to as the Balk-Mehrhoff-Walsh (BMW) index [78]. It is *weighted* by the square root of the inverse price relatives:

$$P_J^{0t,mt} = \left(\prod_{k=1}^{K}\frac{p_k^{mt}}{p_k^{0t}}\right)^{\frac{1}{K}} \approx \sum_{k=1}^{K}\frac{p_k^{mt}}{p_k^{0t}} \cdot \frac{\sqrt{p_k^{0t}/p_k^{mt}}}{\sum_{l=1}^{K}\sqrt{p_l^{0t}/p_l^{mt}}} = P_{BMW}^{0t,mt} \tag{8.11a}$$

---

[77]   Chapter 6 explains how appropriate replacements and quality adjustments keep the samples basically unchanged throughout the year. This is particularly important when products disappear on discount, since chain-linking only matched products then introduces a severe downward drift.

[78]   See Mehrhoff, J.: 'A linear approximation to the Jevons index,' in: v.d. Lippe, P.M. (2007), op. cit.; Balk, B.M. (2008), op. cit. Because it is a linear index, it can be directly compared with other linear indices such as Dutot or Laspeyres(-type) indices using a theorem of v. Bortkiewicz. It should be noted that the approximation is exact when the number of products is not greater than two.

Thus, this index is more robust with respect to the variance of relative prices within an elementary aggregate.

Two important final tests should be added to the above circularity (transitivity) test. The first is the *commensurability test*, i.e. if the units of measurement for each product are changed, then the elementary aggregate index remains unchanged. The Dutot index $P_D^{0t,mt}$ fails this test, since the price levels are affected by the measurement unit. If there are heterogeneous products in the elementary aggregate, this is a rather serious failing and price statisticians should be careful when using this index under these conditions. The other is the *test of determinateness as to prices*, i.e. if any single price tends to zero, then the index should not tend to zero or plus infinity. It can be verified that the Jevons index does not satisfy this test. Thus, when using the Jevons index $P_J^{0t,mt}$, care must be taken to bound the prices away from zero in order to avoid a meaningless index number value (see Section 7.5).

8.4 Annual chain-linking

8.4.1 December as the linking month

The Laspeyres-type index defined by equation (8.2) compares prices in month m of year t to those in December of the preceding year, $t - 1$. When t moves through time, there is for each year a series of 13 index numbers, running from December of year $t - 1$ (its index number being equal to 100) to December of year t[79].

Now these separate 13-month series can be chain-linked together into a single long-term series, which compares month m of year t to some earlier period. The HICP uses December as the linking month (see Chart 8.1). The annually chain-linked Laspeyres-type index:

$$
\begin{aligned}
CP^{b,mt} &= \left(P^{b,12(0)} \cdot P^{0(1),12(1)} \cdot ... \cdot P^{0(t-2),12(t-2)} \cdot P^{0(t-1),12(t-1)} \right) \cdot P^{0t,mt} \\
&= CP^{b,12(t-1)} \cdot P^{0t,mt}
\end{aligned}
\tag{8.17}
$$

compares month m of year t with a certain year b[80]. As noted above, month 0 of any year t is the same as month 12 of year $t - 1$. In principle, each short-term index of this chain-linked series uses a different set of weights and the set of products may vary over time, as some disappear from the market and others enter the market. In this case year b, used in the initial link of the long-term series, is the *index reference period*[81].

---

[79]   Changes in the production methods can be incorporated each December. However, care should be taken to ensure that such changes do not significantly affect the structural characteristics of the entire series of index numbers (see Chapter 10).

[80]   For the HICP, this was initially 1996, where the annual weights of 1996 were *not* price-updated to December of that year. Strictly speaking, the HICP started with the index for January 1997, where 1996 weights were price-updated from the annual average to December.

[81]   'Index reference period' means the period for which the index is set to 100 index points (Article 2(15) of Regulation (EU) 2016/792). For the procedure of re-referencing the HICP to its current index reference period 2015 see Section 8.4.4.

Annual chain-linking of HICPs

Short-term Laspeyres-type indices
with annual weights

100

Annually chain-linked
Laspeyres-type index (HICP)

100

| 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 |

t−2   *t−1*   *t*   *t+1*

Deutsche Bundesbank
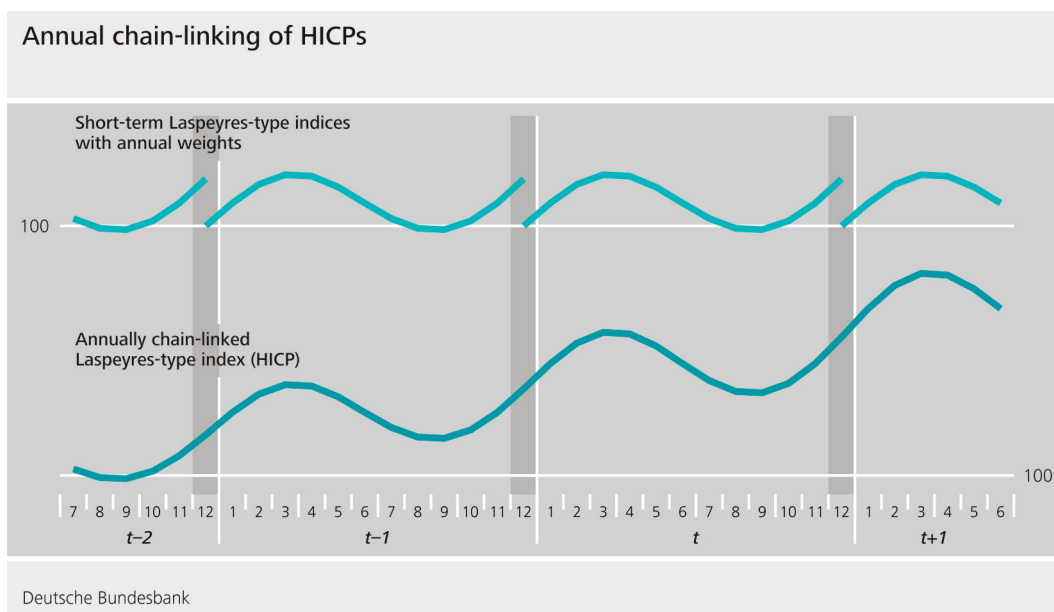
8.4.2 Loss of consistency in aggregation

The technique of chain-linking indices involves losing consistency in aggregation also at higher levels. To see this, return to equation (8.5) and recall that the set of elementary aggregates [82] N, now without loss of generality assumed to be constant over time, is divided into mutually disjoint subsets N_h ($h = 1, …, H$). Then, as explained above, the consistency in aggregation of the short-term Laspeyres-type index (now at higher levels) implies that:

$$P^{0t,mt} = \sum_{h=1}^{H} P_h^{0t,mt} \cdot w_h^{0t,t-1}$$

(8.18)

This holds for any month $m = 1, …, 12$, any year t and any subset of elementary aggregates.

Once chain-linked, however, such a relation does not exist, i.e. there is *no* set of weights (adding up to unity) such that:

$$CP^{b,mt} = \sum_{h=1}^{H} CP_h^{b,mt} \cdot w_h$$

(8.19)

where $CP_h^{b,mt}$ is the chain-linked index for subset $h = 1, …, H$. Even if the weights were constant over the entire time span, this would not imply consistency in aggregation of the chain-linked index, because the chain-linked index would still not reduce to a direct Laspeyres-type index [83].

8.4.3 Aggregation of chain-linked sub-indices

Aggregation is a *hierarchical process*, i.e. elementary aggregates are first aggregated to elementary product groups, which are then aggregated to ECOICOP five-digit sub-class indices, which are in turn aggregated to ECOICOP four-digit class indices, etc. For maximum precision, aggregation should be performed on unrounded indices.

---

[82] See Section 8.3.2 for the change in notation as regards the elementary aggregates.

[83] This is due to the failure of the 'transitivity in prices for fixed value weights test', a (weak) variant of the circularity test, where the weights are held constant while making all price comparisons. The argument found in the literature that the Lowe index is (strongly) transitive would hold true only if the weights, starting from some out-of-date base period, were derived by continual price-updating rather than being genuinely newly observed every year. The only index satisfying the circularity test is a weighted geometric mean of all the individual price ratios, the weights being constant through time. After all, the whole point of chain-linking has been to enable the weights to be continually updated to take account of the changing consumption patterns.

It is important to note that only *unchained indices* should be aggregated. This applies to all levels of index aggregation. Once chain-linked, index number series are no longer consistent in aggregation.

As noted above, the HICP is calculated as a series of 13-month (December to December) aggregate index numbers, where the December of each year is chosen as the linking month. These index numbers are chain-linked by multiplying the chain-linked index for December of the previous year series by the index number for every month of the short-term series (divided by 100). The chain-linked index number for month m of year t is calculated as in the second part of equation (8.17):

$$CP^{b,mt} = CP^{b,12(t-1)} \cdot P^{0t,mt}$$ (8.20)

For the HICP, chain-linking is required each year and December is the linking month.

From time to time, it may be necessary to produce bespoke aggregates which are often requested by users. To achieve this index compilers use unchained indices. To obtain unchained index numbers from their chain-linked counterparts, compilers must divide the chain-linked index number of each month of each year by the chain-linked December index of the previous year (and multiply by 100). The unchained index for month m of year t is calculated by solving equation (8.20) for the short-term series:

$$P^{0t,mt} = \frac{CP^{b,mt}}{CP^{b,12(t-1)}}$$ (8.21)

In order to produce bespoke aggregates from published chain-linked index numbers, the first step is always to unchain the relevant components; the starting point is an *unchained index number series*. The unchained aggregate index numbers are then aggregated together using their relevant weights to produce unchained index number series for the new bespoke aggregate. These index numbers are then chain-linked.

8.4.4   Re-referencing

Every 10 years, there is a requirement to re-reference, or rescale, the HICP to a more recent index reference period ([84]). This can be done by rescaling the chain-linked index (equation (8.17)), i.e. dividing by the arithmetic mean of the index numbers for the months of the index reference year. Thus, the chain-linked index for month m of year t relative to the current index reference period 2015 ([85]) is defined by:

$$CP^{b,mt}_{2015} = \frac{CP^{b,mt}}{\frac{1}{12}\sum_{m=1}^{12} CP^{b,m(2015)}}$$ (8.22)

It is instructive to see what happens in the months of the index reference year. It turns out that:

$$\begin{aligned}
CP^{b,m(2015)}_{2015} &= \frac{P^{0(2015),m(2015)}}{\frac{1}{12}\sum_{m=1}^{12} P^{0(2015),m(2015)}} = \frac{P^{0(2015),m(2015)}}{P^{0(2015),2015}} \\
&= \sum_{i=1}^{N} \left(\frac{P_i^{0(2015),m(2015)}}{P_i^{0(2015),2015}}\right) \cdot \left(w_i^{0(2015),2014} \cdot \frac{P_i^{0(2015),2015}}{P^{0(2015),2015}}\right) \\
&= \sum_{i=1}^{N} P_i^{2015,m(2015)} \cdot w_i^{2015,2014} = P^{2015,m(2015)}
\end{aligned}$$ (8.23)

where $P^{0(2015),2015}$ is the arithmetic mean of the short-term index in this period. Thus, in this situation, the chain-linked index is again a Laspeyres-type index, where the price reference period and index reference period coincide, i.e. the price-updated weights are:

$$w_i^{2015,2014} = w_i^{0(2015),2014} \cdot \frac{P_i^{0(2015),2015}}{P^{0(2015),2015}}$$ (8.4a)

([84])   See Article 5(6) of Regulation (EU) 2016/792, which also requires rescaling in the case of a major methodological change.
([85])   See Article 5(5) of Regulation (EU) 2016/792.

Apart from rounding errors, re-referencing a series of index numbers has no impact on monthly or annual rates of change.

8.5 Rates of change

8.5.1 Monthly rate

The rate of price change between month $m-1$ and month m $(m = 1, ... ,12)$, both of year t, is calculated as the relative change of the chain-linked Laspeyres-type indices, and usually presented as a percentage, i.e. times 100%:

$$\frac{CP^{b,mt}}{CP^{b,(m-1)t}} - 1 = \frac{P^{0t,mt}}{P^{0t,(m-1)t}} - 1.$$

(8.24)

Recall that month 0 of year t is the same as month 12 of year $t-1$ (see above). Also, the computations are dependent on the short-term indices, rather than the chain-linked index.

Using equation (8.2), equation (8.24) can be rewritten as:

$$\frac{P^{0t,mt}}{P^{0t,(m-1)t}} - 1 = \frac{P^{0t,mt} - P^{0t,(m-1)t}}{P^{0t,(m-1)t}} = \frac{\sum_{i=1}^{N}\left(P_i^{0t,mt} - P_i^{0t,(m-1)t}\right) \cdot w_i^{0t,t-1}}{P^{0t,(m-1)t}}$$

$$= \sum_{i=1}^{N}\left(\frac{P_i^{0t,mt}}{P_i^{0t,(m-1)t}} - 1\right) \cdot \left(w_i^{0t,t-1} \cdot \frac{P_i^{0t,(m-1)t}}{P^{0t,(m-1)t}}\right)$$

$$= \sum_{i=1}^{N}\left(P_i^{(m-1)t,mt} - 1\right) \cdot w_i^{(m-1)t,t-1} = P^{(m-1)t,mt} - 1$$

(8.25)

where $P^{(m-1)t,mt}$ is again a Laspeyres-type index, but now with month $m-1$ as the price reference period, i.e. the weights are price-updated to month $m-1$ of year t:

$$w_i^{(m-1)t,t-1} = w_i^{0t,t-1} \cdot \frac{P_i^{0t,(m-1)t}}{P^{0t,(m-1)t}}$$

(8.4b)

The *contribution* of sub-index N, for example, to the overall monthly price change is:

$$\Delta_N^{(m-1)t,mt} = \left(P_N^{(m-1)t,mt} - 1\right) \cdot w_N^{(m-1)t,t-1}$$

$$= \left(\frac{P_N^{0t,mt}}{P_N^{0t,(m-1)t}} - 1\right) \cdot \left(w_N^{0t,t-1} \cdot \frac{P_N^{0t,(m-1)t}}{P^{0t,(m-1)t}}\right)$$

(8.25a)

i.e. rate of change times price-updated weight [86]. The contribution of a higher aggregate is the sum of the contributions of constituent sub-indices.

8.5.2 Annual rate

Very much like the monthly rate, the annual rate of price change between month m of year t and the same month of year $t-1$ is calculated as the relative change of the chain-linked Laspeyres-type indices. The result when the chain-linked index for month m of year t is divided by the chain-linked index for month m of year $t-1$ is a chain-linked index consisting of two parts:

[86] It should be noted that the contribution in January becomes just $\left(P_N^{0t,1t} - 1\right) \cdot w_N^{0t,t-1}$, which means that the short-term index is not rescaled, nor the weight price-updated.

- a ratio of two Laspeyres-type indices for December of year $t - 1$ and month m of year $t - 1$, respectively, both relative to December of year $t - 2$; multiplied by

- a Laspeyres-type index for month m of year t relative to December of year $t - 1$.

Thus:

$$\frac{CP^{b,mt}}{CP^{b,m(t-1)}} = \frac{P^{0(t-1),12(t-1)}}{P^{0(t-1),m(t-1)}} \cdot P^{0t,mt} = P^{m(t-1),12(t-1)} \cdot P^{0t,mt} \tag{8.26}$$

The right-hand side of equation (8.26) shows that the ratio of two Laspeyres-type indices can be written as a Laspeyres-type index for December of year $t - 1$ relative to month m of the same year with price-updated weights:

$$w_i^{m(t-1),t-2} = w_i^{0(t-1),t-2} \cdot \frac{P_i^{0(t-1),m(t-1)}}{P^{0(t-1),m(t-1)}} \tag{8.4c}$$

Since equation (8.26) is a chain-linked index, the rate of change between corresponding months m of adjacent years $t - 1$ and t cannot be written as a weighted mean of sub-indices. It is therefore not possible to express the *contribution* of a sub-index to the overall annual price change as a *simple* formula. This is because chain-linked time series for the HICP may contain statistically-related breaks from one year to another [87].

To show this, we resort to the basket interpretation of the Laspeyres index in equation (8.1) and rewrite equation (8.26) as follows [88]:

$$\begin{aligned}P_L^{m(t-1),12(t-1)} \cdot P_L^{0t,mt} &= \frac{\sum_{i=1}^N p_i^{12(t-1)} \cdot q_i^{t-2}}{\sum_{i=1}^N p_i^{m(t-1)} \cdot q_i^{t-2}} \cdot \frac{\sum_{i=1}^N p_i^{mt} \cdot q_i^{t-1}}{\sum_{i=1}^N p_i^{0t} \cdot q_i^{t-1}} \cdot \frac{P_L^{m(t-1),mt}}{P_L^{m(t-1),mt}} \\ &= \frac{\sum_{i=1}^N p_i^{mt} \cdot q_i^{t-1}}{\sum_{i=1}^N p_i^{m(t-1)} \cdot q_i^{t-1}} \cdot \left(\frac{\sum_{i=1}^N p_i^{m(t-1)} \cdot q_i^{t-1}}{\sum_{i=1}^N p_i^{0t} \cdot q_i^{t-1}} \bigg/ \frac{\sum_{i=1}^N p_i^{m(t-1)} \cdot q_i^{t-2}}{\sum_{i=1}^N p_i^{0t} \cdot q_i^{t-2}} \right)\end{aligned} \tag{8.27}$$

The first factor of the second part of equation (8.27) measures pure price change. The second factor in brackets is a technical distortion that will generally differ from unity. More specifically, the less the price structure in month m of the previous year deviates from that of December of the same year and the smaller the relative quantity change from year to year, the smaller such breaks arise from the change of the weight basis.

Using the theorem of v. Bortkiewicz, we can derive the following equation for the annual rate of a fixed basket in an annually chain-linked Laspeyres index [89]:

$$P_L^{m(t-1),12(t-1)} \cdot P_L^{0t,mt} = P_L^{m(t-1),mt} \cdot \left(1 + \frac{\text{Cov}\left[\frac{p_i^{m(t-1)}}{p_i^{0t}}, \frac{q_i^{t-1}}{q_i^{t-2}} \right]}{\text{E}\left[\frac{p_i^{m(t-1)}}{p_i^{0t}} \right] \cdot \text{E}\left[\frac{q_i^{t-1}}{q_i^{t-2}} \right]} \right) \tag{8.27a}$$

Thus, the technical distortion vanishes if, and only if, there is no (weighted) correlation between the price change from December of the previous year to month m of year $t - 1$ and quantity changes from year $t - 2$ to year $t - 1$ [90]. It is very unlikely that this criterion holds in reality. Worst of all, not even the sign is determined *a priori*.

The measure of inflation that is given prominence in the HICP is the annual rate. When the change in this rate between two consecutive months, i.e.:

---

[87] Section 8.4.2 explains why this holds true even if the weights are constant over the entire time span (reference to the failure of the transitivity in prices for fixed value weights test).

[88] It is straightforward to extend this decomposition to the Young and Lowe indices using the expressions involving quantities.

[89] In principle, this distortion of the annual rate could be avoided by chain-linking over the same month of the previous year (which would then also be the price reference period) rather than December throughout. However, the results from this over-the-year technique would allow only for the meaningful interpretation of annual rates, while the infra-annual pattern of the chain-linked series could be spurious and distorted. Due to the disturbing time series properties, this technique should be avoided.

[90] Should all prices or quantities change at the same rate, the variance and the covariance would be zero.

$$\pi^{mt} - \pi^{(m-1)t} = \left(\frac{CP^{b,mt}}{CP^{b,m(t-1)}} - 1 \right) - \left(\frac{CP^{b,(m-1)t}}{CP^{b,(m-1)(t-1)}} - 1 \right) \tag{8.28}$$

is described, *base effects* (^{91}) are often mentioned. In a purely technical sense, the contribution of the monthly rate between month $m-1$ and month m, both of year $t-1$, to the change in the annual rate could be referred to as a base, or denominator, effect.

To show this, we approximate equation (8.28) by:

$$\pi^{mt} - \pi^{(m-1)t} \approx \left(\frac{CP^{b,mt}}{CP^{b,(m-1)t}} - 1 \right) - \left(\frac{CP^{b,m(t-1)}}{CP^{b,(m-1)(t-1)}} - 1 \right) \tag{8.28a}$$

where the approximation $\pi^{mt} \approx \ln CP^{b,mt} - \ln CP^{b,m(t-1)}$ (and similarly with $\pi^{(m-1)t}$) is used (^{92}).

Thus, the difference between the annual rates in two subsequent months is approximately the same as the difference between the monthly rate in the current month and the monthly rate one year earlier. This illustrates that the change in the annual rate from one month to the next reflects both recent price changes and price movements 12 months earlier. For example, if the index declines in the period from November to December of year $t-1$, this will amplify the change in the annual rate between November and December of year t (^{93}).

8.5.3 Contributions to the annual rate

In general, the concept of contributions *per se* is no longer well defined in chain-linked indices and different approaches produce different results with different properties. Here, we present two competing approaches: one that assures additivity (Ribe contributions) and one that has a direct interpretation (Kirchner contributions).

As one of many possible conventions circumventing the problems associated with the abovementioned statistical break, Ribe (1999, *mimeo*) showed how the rate of change of a chain-linked index can be decomposed into the sum of the contributions of the sub-indices covered by the higher aggregate.

The annual rate can be decomposed additively into a *this-year term* (TYT) and a *last-year term* (LYT), according to (^{94}):

$$
\begin{aligned}
P^{m(t-1),12(t-1)} \cdot P^{0t,mt} - 1 &= \left[P^{m(t-1),12(t-1)} \cdot \left(P^{0t,mt} - 1 \right) \right] \\
&\quad + \left[\left(P^{m(t-1),12(t-1)} - 1 \right) \right] \\
&= TYT^{m(t-1),mt} + LYT^{m(t-1),mt}
\end{aligned}
\tag{8.29}
$$

where the first bracketed term is the this-year term from December of year $t-1$ to month m of year t, adjusted 'to take account of the differences in the overall price levels involved in the comparisons', and the second is the last-year term from month m of year $t-1$ to December of the same year.

Again, the interesting point is to decompose the overall annual price change into components by sub-indices. The this-year term and the last-year term can now each be decomposed, analogously to the monthly contribution for sub-index N, according to:

$$
\begin{aligned}
TYT_N^{m(t-1),mt} &= P^{m(t-1),12(t-1)} \cdot \left(P_N^{0t,mt} - 1 \right) \cdot w_N^{0t,t-1} \\
LYT_N^{m(t-1),mt} &= \left(P_N^{m(t-1),12(t-1)} - 1 \right) \cdot w_N^{m(t-1),t-2}
\end{aligned}
\tag{8.29a}
$$

(^{91})   See *ECB Monthly Bulletin*, January 2005.

(^{92})   Since the total HICP base effect is the monthly rate one year earlier, the contribution of a sub-index to the total HICP base effect is its contribution to the previous year's monthly rate.

(^{93})   However, the monthly rate, and hence the base effect, are affected by seasonally fluctuating prices, which is not desirable from an economic perspective.

(^{94})   Note that the short-term indices are rescaled (see third part of equation (8.26)) and the weights are price-updated (see equation (8.4c)).

It should be noted that the factor $P^{m(t-1),12(t-1)}$ in TYT pertains to the overall index. This choice is arbitrary, since the factor is also part of the price change to be decomposed (see LYT). Had $P^{0t,mt}$ been held constant in LYT instead, which is equally justified, the resulting contributions would be different, though still additive [95].

The special case of December ($m = 12$) gives:

$$TYT_N^{m(t-1),mt} = \left(P_N^{0t,12t} - 1\right) \cdot w_N^{0t,t-1}; LYT_N^{m(t-1),mt} = 0 \tag{8.29b}$$

As another measure to ascertain the importance of a sub-index for price dynamics, the Kirchner contribution shows the difference between the actual annual rate and that which one would obtain if, under otherwise equal conditions, this sub-index had remained constant vis-à-vis the comparison period [96]. Unlike the Ribe contributions, these contributions thus have a direct interpretation. For example, the Kirchner contribution of sub-index N is:

$$
\begin{aligned}
\Delta_N^{m(t-1),mt} &= P^{m(t-1),12(t-1)} \cdot P^{0t,mt} \\
&\quad - \left(P^{m(t-1),12(t-1)} - \left(P_N^{m(t-1),12(t-1)} - 1\right) \cdot w_N^{m(t-1),t-2}\right) \\
&\quad \cdot \left(P^{0t,mt} - \left(P_N^{0t,mt} - 1\right) \cdot w_N^{0t,t-1}\right) \\
&= P^{m(t-1),12(t-1)} \cdot \left(P_N^{0t,mt} - 1\right) \cdot w_N^{0t,t-1} \\
&\quad + P^{0t,mt} \cdot \left(P_N^{m(t-1),12(t-1)} - 1\right) \cdot w_N^{m(t-1),t-2} \\
&\quad - \left(P_N^{0t,mt} - 1\right) \cdot \left(P_N^{m(t-1),12(t-1)} - 1\right) \cdot w_N^{0t,t-1} \cdot w_N^{m(t-1),t-2}
\end{aligned}
\tag{8.30}
$$

The expression on the right-hand side of the equation has three terms. The first two terms relate to the price change of the sub-index before and after the chain-linking in December, the third term refers to the whole 12-month period. The latter term will normally be dominated by the former two terms because the weight part is approximately square. Owing to the statistical break from one year to another, the sum of the Kirchner contributions of the sub-indices for this period is not necessarily equal to the annual rate [97].

The special case of December ($m = 12$) gives:

$$\Delta_N^{m(t-1),mt} = \left(P_N^{0t,12t} - 1\right) \cdot w_N^{0t,t-1} \tag{8.30a}$$

which is again additive.

The difference between the Kirchner contributions presented here and the Ribe contributions is:

$$\left(P_N^{m(t-1),12(t-1)} - 1\right) \cdot w_N^{m(t-1),t-2} \cdot \left(\left(P^{0t,mt} - 1\right) - \left(P_N^{0t,mt} - 1\right) \cdot w_N^{0t,t-1}\right) \tag{8.30b}$$

which is expected to be close to zero; it is exactly zero in December. As such it can be said that the Kirchner contributions have an exact direct interpretation and are approximatively additive (and vice versa for the Ribe contributions).

8.5.4 Annual average rate

Aggregation of the Laspeyres-type index from months to the year is performed by means of *arithmetically* averaging the 12 months of year t, as the weights remain constant within a *calendar* year [98]:

$$CP^{b,t} = \frac{1}{12}\sum_{m=1}^{12} CP^{b,mt} = CP^{b,12(t-1)} \cdot \left(\frac{1}{12}\sum_{m=1}^{12} P^{0t,mt}\right) = CP^{b,12(t-1)} \cdot P^{0t,t} \tag{8.31}$$

[95]   This gives rise to the idea of a *modified* Ribe contribution, which takes the arithmetic average of the two alternatives. While this is still additive, it is somewhat less arbitrarily defined.

[96]   See Eurostat (2013), *Handbook on Quarterly National Accounts*, Publications Office of the European Union, paragraph 6.109. The Deutsche Bundesbank proposed this way to compute contributions to GDP growth, which is adapted here to fit with the HICP concept.

[97]   To reiterate, the additivity of the Ribe contributions is imposed and the contributions are derived accordingly.

[98]   Should the 12-month average not correspond to a calendar year, nothing can be said about its properties.

The annual average rate is obtained by dividing the arithmetic mean of the chain-linked indices for year t by a mean of the same indices for year $t-1$, i.e.:

$$\frac{CP^{b,t}}{CP^{b,t-1}} = \frac{P^{0(t-1),12(t-1)}}{P^{0(t-1),t-1}} \cdot P^{0t,t} = P^{t-1,12(t-1)} \cdot P^{0t,t} \tag{8.31a}$$

Much like the annual rate, the result is a chain-linked index consisting of two parts:

- a ratio of two Laspeyres-type indices for December of year $t-1$ and the entire previous year, respectively, both relative to December of year $t-2$, multiplied by

- a Laspeyres-type index for the entire year t relative to December of year $t-1$.

The first part can be written as a Laspeyres-type index for December of year $t-1$ relative to the entire previous year. The corresponding price-updated weights are obtained as follows:

$$w_i^{t-1,t-2} = w_i^{0(t-1),t-2} \cdot \frac{P_i^{0(t-1),t-1}}{P^{0(t-1),t-1}} \tag{8.4d}$$

It is straightforward to see that the relative importance of a price change for the annual average rate also depends on the month in which it occurs. A permanent upward shock to the price level in January, say, has an impact 12 times greater than the same shock in December. A first-order Taylor series approximation of equation (8.31a) around $P^{\tau-1,\tau} = 1 \ (\tau = 2(t-1), \dots, 12t)$ yields:

$$
\begin{aligned}
P^{0(t-1),12(t-1)} \cdot {} & \frac{\frac{1}{12}\sum_{m=1}^{12} P^{0t,mt}}{\frac{1}{12}\sum_{m=1}^{12} P^{0(t-1),m(t-1)}} - 1 \\
\approx {} & \frac{1}{12}P^{1(t-1),2(t-1)} + \frac{2}{12}P^{2(t-1),3(t-1)} + \cdots + \frac{11}{12}P^{11(t-1),12(t-1)} \\
& + \frac{12}{12}P^{0t,1t} + \frac{11}{12}P^{1t,2t} + \cdots + \frac{2}{12}P^{10t,11t} + \frac{1}{12}P^{11t,12t}
\end{aligned}
\tag{8.31b}
$$

Annex 8: Numerical example

The Excel file contains three groups of tabs. In the blue tabs (*Index* and *Item weights*) the data referring to the changing composition of the euro area are those published by Eurostat on 22 February 2017. The indices and item weights are both rounded to two decimals, which will affect the calculation results. They are, nonetheless, exact except for rounding differences. The grey tabs (*Aggregation*, *Non-consistency*, *Re-referencing (1) and (2)*, and *Disaggregation (1) and (2)*) contain the examples relating to Section 8.4, while the yellow tabs (*Monthly rate*, *Annual rate*, *Base effect* and *Annual average rate*) contain those relating to Section 8.5.

Aggregation

The five special aggregates (processed food, unprocessed food, non-energy industrial goods, energy and services) are aggregated to the total HICP. The procedure involves three steps:

- Unchain the chain-linked indices to obtain the short-term series using equation (8.21);

- Aggregate the unchained sub-indices to the total short-term index using the item weights provided and equation (8.18); and

- Chain-link the short-term series together into a single long-term series using December as the linking month and equation (8.20).

Non-consistency

Here it is shown that aggregating the chain-linked indices directly using equation (8.19), rather than their unchained counterparts, does not ensure consistency in aggregation. The zero check is different from zero, not only because of rounding, but particularly because the Laspeyres-type index fails the circularity test.

Re-referencing

Re-referencing the index with reference period 2005=100 to an index with reference period 2015=100 is simply a matter of applying the *rule of three* using equation (8.22), as shown on the first tab. The second tab derives the chain-linked index in the new index reference period from rescaled short-term indices and price-updated weights using equations (8.23) and (8.4a).

Disaggregation

An exclusion measure without food and energy is derived from the total HICP. The procedure is the same as for aggregation, except that we deduct sub-indices from the total on the first tab rather than adding them to form the total. The second tab shows the same calculation, but with aggregation of the constituent sub-indices.

Monthly rate

The monthly rate has been defined in equation (8.24). The calculation of contributions, here for the energy sub-index, involves the short-term indices, so the chain-linked indices are first unchained, again using equation (8.21). As shown in equations (8.25) and (8.4b), the indices have to be rescaled and the item weights price-updated, respectively. On this basis, the contribution of energy to the monthly rate of the total HICP is derived using equation (8.25a). In December 2016, for example, the contribution of energy to the monthly rate of the total HICP of 0.5 % was 0.2 percentage points (pp).

Annual rate

The calculation for the annual rate is repeated analogously to the monthly rate, using equation (8.26). Again, the contributions involve the short-term indices and, after unchaining the chain-linked indices using equation (8.21), the indices derived in this way are rescaled using equation (8.29) and the item weights price-updated using equation (8.4c). The Ribe contribution of energy to the annual rate of the total HICP follows from equation (8.29a) as the sum of the *this-year term* and the *last-year term*. The Kirchner contribution, on the other hand, involves three terms, as given in equation (8.30). In December 2016, for example, the contribution of energy to the 1.1 % annual rate of the total HICP was 0.2 pp. As is to be expected, the two contributions are virtually identical.

Base effect

The base, or denominator, effect on the change in the annual inflation rate in the HICP (equation (8.28)) is the monthly rate observed one year earlier, the subtrahend of equation (8.28a). In December 2016, for example, the month-on-month change in the annual rate of energy was 3.6 pp; approximately half of this was due to the monthly rate of –1.8 % in December 2015. Since the base effects use information from 12 months ago, the monthly rates of the year 2016 will be the base effects for the year 2017, i.e. the base effect for energy in January 2017 will be 2.7 pp upwards (which will also translate into the total HICP base effect, with 0.3 pp upward contribution in January 2017) ([99]).

Annual average rate

The annual average index is calculated using equation (8.31) and the annual average rate using equation (8.31a). The average annual rate can be approximated from the monthly rates using equation (8.31b).

([99]) See *ECB Economic Bulletin*, Issue 1/2017 (energy prices are assumed to show no seasonal influences).

9 HICP-constant tax rates and HICP-administered prices

9.1   Introduction

This chapter deals with the HICP at constant tax rates (HICP-CT) (Section 9.2) and HICP-administered prices (HICP-AP) (Section 9.3). These are analytical indices which complement the HICP in gauging the extent to which inflation is due to movements in free market prices.

The HICP-CT and HICP-AP are referred to in Regulation (EU) 2016/792 (the Framework Regulation). They complement each other in the sense that they capture different aspects of price changes that are influenced by governments. They are compiled according to transparent rules, as described in this chapter. Limitations in the use and interpretation of these indices are also dealt with in the chapter.

The HICP-CT is a series of inflation indices which for most countries starts in 2002. It follows the same computation principles as the HICP, but is based on prices where tax rates are kept at the level applying in December of the preceding year.

The HICP-CT is an important tool for estimating the contribution of tax changes to inflation. It does not provide an exact measure of the actual contribution, but an approximate upper bound. The difference between HICP and HICP-CT rates of change corresponds to the theoretical contribution of tax changes to overall inflation, assuming an instantaneous and complete pass-through of tax rate changes on the prices paid by the consumer.

The HICP and the HICP-CT are identical except for the treatment of taxes. The methodology for the latter is set out in the *HICP-CT manual* ([100]). The HICP-CT does not adjust or account for any subsidies that may affect prices of goods or services. It might appear that the treatment is thus asymmetrical, given that subsidies could formally be seen as negative taxes, or *vice versa*, but it is not actually feasible to adjust for subsidies.

The HICP-AP is a series of inflation indices first released by Eurostat in February 2010. The indices track the development of prices and prices which are not administered. Administered prices are those that are either directly set or significantly influenced by government policy. The aim of the HICP-AP is similar to that of the HICP-CT: to isolate the impact on inflation of government interventions.

The aim and main use of the HICP-AP is to show the development of prices which are either fully or mainly administered by government or the public sector. It helps users by indicating the extent to which inflation is due to movements in free market prices.

It should be noted that the HICP-AP can only be a supplementary tool for economic analysis; it is not intended to replace a detailed analysis of price changes in the HICP and their causes. There may be other (non-policy) factors, including market developments, behind changes in the prices of administered goods and services. This is particularly true for some types of mainly administered prices. World energy and commodity prices and technological progress, for example, influence the price developments of many goods and services, although in most cases it is not possible to distinguish between these factors. Similarly, changes in the HICP-AP can provide only an approximation of price changes due to administrative decisions and should be interpreted with caution.

The total effect of government interventions is not measured in a single index series, as the HICP-CT includes only tax rate changes and the HICP-AP includes only interventions pertaining to the setting of prices.

9.2   HICP at constant tax rates

9.2.1   Legal obligations, definitions and concepts

Article 2 of Regulation (EU) 2016/792 contains the following definitions:

> '(7) "harmonised index of consumer prices at constant tax rates" or "HICP-CT" means the index that measures changes in consumer prices without the impact of changes in tax rates on products over the same period of time;

([100]) *HICP-CT manual*, Working Group Harmonisation of Consumer Price Indices, 2009, Document HCPI 09/547-rev.3, Luxembourg: Eurostat.

(8) "tax rate" means a tax parameter and may be a certain percentage of the price or an absolute tax amount levied on a physical unit;

[…]

(17) "basic information" means data covering:

(a) with reference to the HICP and the HICP-CT:

> *(i) purchase prices of products which need to be taken into account in order to compute sub-indices in accordance with this Regulation;*
>
> *(ii) characteristics that determine the product price;*
>
> *(iii) information on taxes and excise duties levied;*
>
> *(iv) information as to whether a price is fully or partially administered; and*
>
> *(v) weights reflecting the level and structure of the consumption of the products concerned.'*

The reference in paragraph 17 to 'taxes and excise duties levied' is particularly relevant to the HICP-CT.

9.2.2 Idea, use and interpretation

Meaning of constant tax rates

The HICP-CT is an index that measures price changes in the same way as the HICP, except that rates of taxes on products are kept constant in the comparison period vis-à-vis the price reference period, i.e. through time. Hence, in the event of a tax rate change, the difference in the current monthly or annual rate of change between the two indices corresponds to the contribution of the tax change to price change, i.e. the overall rate of HICP inflation, assuming that tax changes are passed on instantaneously and fully.

As defined in Article 2(8) of Regulation (EU) 2016/792, the term *tax rate* basically refers to a parameter that is the object of a political decision. A tax rate can be given in different forms, usually one of the following:

- as a *monetary amount per physical unit* of the product in question, e.g. € x per cigarette; this is sometimes (ambiguously) called a *specific* tax;

- as a *percentage of the price* of the product (*ad valorem* tax (or rate)); or

- in the form of a *value added tax* (VAT), a percentage of the total of the price of the product and any other taxes levied on the purchase of the product.

The main aim of the HICP-CT is to enable comparisons of rates of change in the HICP and the HICP-CT. Thus, it is of analytical interest when tax rate changes occur between the price reference period and the comparison period.

The following example shows how this works:

Table 9.1: **Example of how the HICP and HICP-CT can be compared**

Period	HICP	HICP-CT	Annual link, year *t*	
			HICP	HICP-CT
Index reference year	100	100		
***t*–1 Dec**	120.5	117.6	100	100
***t* Jan**	120.7	117.49	100.17	99.91
***t* Aug**	121.3	118.11	100.66	100.43

The difference between 100.66 and 100.43 in the annual link reflects the impact of changes in tax rates since December. The difference between 121.30 and 118.11 is the cumulative effect of tax rate changes since the index reference year.

From the definition of the HICP-CT, it follows that the changes in HICP-CT equal those in HICP over a period in which no tax rates change.

For strict interpretation of the comparison of annual rates of change, it should be noted that in the chained index, the reference tax rates are updated for each year in December of the preceding year. By comparing the HICP with the HICP-CT, we see the effects of tax changes on inflation for the current year. Over periods of more than one year, there is a cumulative impact of each year's tax changes, giving lasting contributions to a difference in level between the two index series.

Limitations in use of the HICP-CT

The HICP-CT assumes that changes in tax rates are passed on to the consumer instantaneously and fully. However, this is often not the case, and as a result the HICP-CT tends to indicate an upper bound for the impact of tax changes on inflation. In practice, taxes are not always passed on to consumers at the same time as they are introduced. Retailers can adjust the prices of their products to reflect tax changes later, as and when new stock is sold, or they can anticipate the rate change and adjust their prices before the changed tax rate is applied. They may also absorb part or all of a tax change by raising their prices by less than expected or even keeping prices constant. Thus, the HICP-CT might overestimate a price increase, e.g. if stock is sold at previously applicable prices.

As it keeps constant only the rates of product tax that are applied at the retail stage (the point of purchase), the HICP-CT does not eliminate indirect effects of tax changes, such as price reductions in response to consumer reactions to taxes, or tax changes at earlier stages of production or trade.

Quality requirements and comparability

The HICP-CT is part of the HICP system and should thus meet the same quality requirements as the HICP. As explained above, it is vital to the main use of the HICP-CT that it be fully comparable with the HICP and across countries.

In practice it is necessary to strike a balance between completeness, feasibility and cost to produce the HICP-CT. Compromises are acceptable as regards the inclusion/exclusion of taxes with a relatively small impact on the overall HICP (see Section 9.2.4 below). This may apply to local taxes and taxes levied on product groups with a low weight in the basket, e.g. sugar tax.

Tax rate ad valorem versus per physical unit

Differences in national tax structures can lead to different effects of tax changes on the HICP-CT. The following fictitious example illustrates this.

Suppose that country A applies an ad valorem *tax on cigarettes of 20 % of the purchase price and that the purchase price of a packet of cigarettes in the price reference period is €3 (i.e. the amount of tax per packet is €0.60).*

Country B also has a price per packet of €3 in the price reference period, which includes a per unit tax per packet of €0.60.

In a subsequent period, a packet of cigarettes costs €3.60 in both countries (an increase of 20 %). In country A, the ad valorem *tax rate is still 20 %, so the amount of tax per packet is €0.72. In country B, it is decided that the per unit tax per package should be raised from €0.60 to €0.72.*

The example is summarised in the following table.

Table 9.2: Ad valorem versus per unit taxes, an example

Country	Period	Price incl. tax	*Ad valorem* tax	Per unit tax	Tax equivalent to	Price pre-tax	Price at tax rate of reference period
A	Reference	€3.00	20 %	-	€0.60	€2.40	€3.00
A	Later	€3.60	20 %	-	€0.72	€2.88	€3.00
B	Reference	€3.00	-	€0.60	20 %	€2.40	€3.00
B	Later	€3.60	-	€0.72	20 %	€2.88	€3.48

Calculations:

3.00 − 0.60 = 2.40

3.60 − 0.72 = 2.88

2.40 + 0.60 = 3.00

2.88 + 0.60 = 3.48

In country A, the HICP-CT would show a price rise of 20 % for a packet of cigarettes (the same as in the normal index, since there was no change in the tax rate). In country B, the HICP-CT would show a price rise of 16 % (which follows from applying the price reference period tax rate). Thus, while the effect on the amount of tax paid is the same in both countries, the resulting HICP-CTs differ. This is a consequence of applying taxes with different structural characteristics (e.g. *ad valorem* tax as opposed to perunit tax) to the same product.

A potential alternative to keeping tax rates constant could be keeping the monetary tax amount per product unit constant. However, a price index of that type would be adjusted for tax amount changes that automatically result from price changes, including when the tax rates have not changed. This would not be appropriate for the HICP-CT, which should move differently from the HICP only when tax rates change.

The HICP-CT is designed to measure the impact of taxation policy, as opposed to measuring the development of the actual amount of taxes paid by the consumer.

The following example further demonstrates how it works in dealing with perunit tax rates:

Table 9.3 Example of per-unit tax rates with tax rate in € per cigarette

HICP: index of observed prices				
Period	(€ per cig.)	(€ per cig.)	(€ per cig.)	Index
0*t*	0.05	0.25	0.25	
mt	0.08	0.35	0.35	140.00
HICP-CT: index of prices at price reference period (0*t*) *tax rate*				
Period	(€ per cig.)	(€ per cig.)	(€ per cig.)	(€ per cig.) at tax rate of time *t*=0	Index
0*t*	0.05	0.25	0.2000	0.25	
mt	0.08	0.35	0.2700	*0.3200*	128.00

Calculations:

0.35-0.08 = 0.2700

0.2700+0.05 = 0.3200

03200 / 0.25 × 100 = 128.00

9.2.3   Taxes in scope

Rules on taxes in scope

Taxes in scope are taxes on products relating to household final monetary consumption expenditure and taxes directly linked to the level of final consumption. Table 9.4 lists the forms of tax that are currently relevant for the EU. Subsidies on products are not taken into consideration in the HICP-CT for the time being.

For the calculation of the HICP-CT, the following rules apply:

a. Account is taken of each tax category which on its own covers 2 % or more of total revenue from all taxes; and

b. Taxes accounting for a minimum of 90 % of total revenue of taxes are kept constant.

The provisions of the regulation rules do not cover local or regional taxes which the local or regional authorities have the right to determine themselves, including setting the revenue level. If the local or regional authority's power over the setting of tax rates is limited and it is collecting tax revenues based on centrally determined legislation and rules, the tax should be included in the HICP-CT, subject to the above rules. In any case, the thresholds set in a) and b) shall also apply for these taxes.

Table 9.4: ESA classification of taxes on products in scope of the HICP-CT

ESA classification	ESA paragraph reference	Description	HICP code
D.211	4.17.	Value-added type taxes (VAT)	D.211
D.2122	4.18.b.5	Taxes on specific services provided by non-resident enterprises to resident units within the economic territory	D.2122E
D.214	4.20.a	Excise duties and consumption taxes (other than those included in taxes and duties on imports)	D.214A
D.214	4.20.d	Car registration taxes	D.214D
D.214	4.20.e	Taxes on entertainment	D.214E
D.214	4.20.g	Taxes on insurance premiums	D.214G
D.214	4.20.h	Other taxes on specific services: hotels or lodging, housing services, restaurants, transportation, communication, advertising	D.214H
-	-	Other taxes on products n.e.c.	D.214L

The distinction between taxes and administrative fees

The distinction in ESA 2010 (paragraph 4.79(d)) between *taxes* and *administrative fees* is relevant for the scope of the HICP in general (see Chapter 2). It is important for the HICP-CT, because the latter should be considered as administered prices, not taxes, and therefore should not be kept constant in the HICP-CT.

Tax reference period

The *tax reference period* is the period which is used to determine the tax rate to be kept constant for the compilation of the HICP-CT. Each year the tax reference period shall be set to the month December of the preceding year. This means that the price reference period (for HICP and HICP-CT) and the tax reference period (for HICP-CT) are the same.

When a new tax is introduced for a specific product in the course of the current year, its reference period tax rate is set to zero. For the next year, the tax rate of December of the present year is used as the reference rate.

The HICP-CT is chained at the end of every year in the same way as the HICP (see Chapter 8). This consistency of method is needed to ensure its comparability with the HICP (see Section 9.2.2).

For the same reason, the set of weights used for the HICP-CT is identical to that used for the HICP. The weights reflect the actual expenditure shares of the weight reference period, price-updated to December of the previous year.

Time of entering tax rate changes

Changes in tax rates which enter into force on the first day of a month are reflected in the compilation of the indices for that month.

Changes in tax rates which enter into force later than the first day are reflected in the compilation of the indices for the following month.

A basic assumption of the HICP-CT is that tax changes are passed on instantaneously and entirely.

In principle, the tax rate actually charged on the observed price should always be used in the calculation of HICP-CT, even if the applicable tax rate is known to have changed. In some cases, such as for cigarettes, stocks with *pre-change* price tags or tax stamps are available on the market for some time after the tax change has come into force. In such circumstances, the change in the tax rate actually charged is not necessarily instantaneous. In other cases (e.g. as regards fuel duties and the like), changes in tax rates are applied universally either from the time they are announced or from another specified date. In these circumstances, the change is captured in full in the month in which it occurs (if this is on the first day of the month) or in the following month.

It may or may not be known to price statisticians may or may not know whether prices collected include the previous or updated tax rates. It is important that such information is gathered during the price collection. Where it is available, the tax actually paid should be reflected in the HICP-CT.

9.2.4 Calculation and index formulas

Description of index calculations in algebraic form

The treatment below gives operational formulas for calculating the HICP-CT.

A Laspeyres-type constant tax rate price index $CTP^{0t,mt}$ may be written as follows:

$$CTP^{0t,mt} = \sum_{i=1}^{N} \frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} \cdot w_i^{0t,t-1} \qquad (9.2.1)$$

where $w_i^{0t,t-1}$ are the HICP-CT weights, which are the same as for the HICP, i.e. they are not adjusted (see Chapters 3 and 8).

Further $p_i^{mt}(\tau_i^{0t})$ denotes the constant tax rate price of product i (i=1,2, …, N) in month m (m=1,…,12) of year t. The vector τ_i^{0t}, pertaining to month $0t$, i.e. December (t–1), comprises product-related taxes that are within the scope of a constant tax rate price index. For each product i, the vector τ_i^{0t} usually comprises up to three tax rates: $\tau_i^{0t} = (\alpha_i^{0t}, \beta_i^{0t}, \gamma_i^{0t})$.

Three forms of taxes on products are here distinguished (see Section 9.2.2):

- α_i^{0t} — tax levied at a given rate per physical unit of product i in month $0t$, $\alpha_i^{0t} \geq 0$;

- β_i^{0t} — tax levied at a given rate per monetary unit of the price of product i in month $0t$ (*ad valorem* tax), $\beta_i^{0t} \geq 0$; and

- γ_i^{0t} — value-added tax (VAT) levied at a given rate on the price for product i in month $0t$, $\gamma_i^{0t} \geq 0$.

Similarly, $p_i^{mt}(\tau_i^{mt})$ denotes the observed price in month mt, with $\tau_i^{mt} = (\alpha_i^{mt}, \beta_i^{mt}, \gamma_i^{mt})$.

The sequence of taxes (i.e. what price an *ad valorem* tax is levied on) may differ by type of product:

- The per unit tax α_i^{0t} may be levied before or after the *ad valorem* tax β_i^{0t}; while

- The *ad valorem* tax β_i^{0t} is levied either directly on the pre-tax price or on the pre-tax price plus the per unit tax α_i^{0t}, or it is linked to the final purchaser price.

The VAT γ$_i$ is levied on the pre-tax price plus all other taxes (the last tax to be applied).

The exact sequence of the taxes will have to be considered in each case. The order in which the taxes are applied in the tax system can vary between countries and product categories, e.g. a per-unit tax may be levied before or after an *ad valorem* tax which is also in force. However, the VAT is generally applied last, after all other taxes. For tobacco, the *ad valorem* tax is always applied on gross prices, including any per unit tax.

In the HICP-CT calculation, taxes should be considered as being applied in the same order as in the tax system of the country in question.

To show the formulas reflecting differing taxation practices, three possible cases are presented here. However, other taxation rules may exist and the calculations have to be made accordingly.

Case 1

Sequence of taxes:

- the *ad valorem* tax β_i^{mt} is levied on the pre-tax price plus the per unit tax α_i^{mt};

- the VAT γ_i^{mt} is levied on the pre-tax price plus all other taxes (it is the last tax to be applied).

The purchaser price p_i^{mt} to be paid for a product *i* in period *mt* may be expressed as follows:

$$p_i^{mt} = \tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\left(\tilde{p}_i^{mt} + \alpha_i^{mt}\right) + \gamma_i^{mt}\left[\tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\left(\tilde{p}_i^{mt} + \alpha_i^{mt}\right)\right] \tag{9.2.2}$$

where $\tilde{p}_i^{mt}$ denotes the pre-tax price of product *i* in period *mt*, which is the price excluding product related taxes. Equation (9.2.2) can be rewritten as:

$$p_i^{mt} = \left(1 + \gamma_i^{mt}\right)\left(1 + \beta_i^{mt}\right)\left(\tilde{p}_i^{mt} + \alpha_i^{mt}\right) \tag{9.2.3}$$

Solving this for $\tilde{p}_i^{mt}$, the pre-tax price of a product is given by:

$$\tilde{p}_i^{mt} = \frac{p_i^{mt}}{\left(1+\gamma_i^{mt}\right)\left(1+\beta_i^{mt}\right)} - \alpha_i^{mt} \tag{9.2.4}$$

The 'constant tax rate' price, i.e. the (unobservable) price of product *i* in the comparison period *mt* which would have appeared if the reference period (0*t*) tax rates had been in force, can be calculated as:

$$p_i^{mt}\left(\tau_i^{0t}\right) = \left(1 + \gamma_i^{0t}\right)\left(1 + \beta_i^{0t}\right)\left(\tilde{p}_i^{mt} + \alpha_i^{0t}\right) \tag{9.2.5}$$

Given this and referring to equation (9.2.3), the price relation that reflects the relative price movement of product *i* from 0*t* to *mt* is:

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} = \frac{\left(1+\gamma_i^{0t}\right)\left(1+\beta_i^{0t}\right)\left(\tilde{p}_i^{mt}+\alpha_i^{0t}\right)}{\left(1+\gamma_i^{0t}\right)\left(1+\beta_i^{0t}\right)\left(\tilde{p}_i^{0t}+\alpha_i^{0t}\right)} = \frac{\tilde{p}_i^{mt}+\alpha_i^{0t}}{\tilde{p}_i^{0t}+\alpha_i^{0t}} \tag{9.2.6}$$

Case 2

Sequence of taxes:

- the *ad valorem* tax β_i^{mt} is levied on the pre-tax price;

- the VAT γ_i^{mt} is levied on the pre-tax price plus all other taxes (it is the last tax to be applied).

The purchaser price p_i^{mt} to be paid for a product *i* in period *mt* can now be written as follows:

$$p_i^{mt} = \tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\tilde{p}_i^{mt} + \gamma_i^{mt}\left(\tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\tilde{p}_i^{mt}\right) \tag{9.2.7}$$

or

$$p_i^{mt} = (1 + \gamma_i^{mt})(\tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\tilde{p}_i^{mt}) = \left(1 + \gamma_i^{mt}\right)\left(1 + \beta_i^{mt}\right)\tilde{p}_i^{mt} + \left(1 + \gamma_i^{mt}\right)\alpha_i^{mt} \tag{9.2.8}$$

The pre-tax price of product *i* is now given by:

$$\tilde{p}_i^{mt} = \frac{p_i^{mt}}{(1+\gamma_i^{mt})(1+\beta_i^{mt})} - \frac{\alpha_i^{mt}}{1+\beta_i^{mt}} \tag{9.2.9}$$

The 'constant tax rate' price, i.e. the (unobservable) price of product i in the comparison period mt which would have appeared if the reference period ($0t$) tax rates had been in force, can be calculated as:

$$p_i^{mt}(\tau_i^{0t}) = (1 + \gamma_i^{0t})(\tilde{p}_i^{0t} + \alpha_i^{0t} + \beta_i^{0t}\,\tilde{p}_i^{0t}) \tag{9.2.10}$$

Given this and using equation (9.2.8), the price relation that reflects the relative price movement of product i from $0t$ to mt is:

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} = \frac{(1 + \gamma_i^{0t})(\tilde{p}_i^{mt} + \alpha_i^{0t} + \beta_i^{0t}\,\tilde{p}_i^{mt})}{(1 + \gamma_i^{0t})(\tilde{p}_i^{0t} + \alpha_i^{0t} + \beta_i^{0t}\,\tilde{p}_i^{0t})} = \frac{\tilde{p}_i^{mt} + \alpha_i^{0t} + \beta_i^{0t}\,\tilde{p}_i^{mt}}{\tilde{p}_i^{0t} + \alpha_i^{0t} + \beta_i^{0t}\,\tilde{p}_i^{0t}} \tag{9.2.11}$$

This case could also be described with the same formula as case 1, assuming that the perunit tax rate α' could be defined as $\alpha/(1+\beta)$. The price relation (9.2.11) then becomes:

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} = \frac{(1+\gamma_i^{0t})\,(1+\beta_i^{0t})\,(\tilde{p}_i^{mt} + \alpha_i^{0t})}{(1+\gamma_i^{0t})\,(1+\beta_i^{0t})\,(\tilde{p}_i^{0t} + \alpha_i^{0t})} = \frac{\tilde{p}_i^{mt} + \alpha_i^{0t}}{\tilde{p}_i^{0t} + \alpha_i^{0t}} \tag{9.2.11a}$$

Case 3

Sequence of taxes:

- the *ad valorem* tax β_i^{mt} is linked to the final purchaser price;

- the VAT γ_i^{mt} is levied on the pre-tax price plus all other taxes (it is the last tax to be applied, even though it has some impact on the *ad valorem* tax).

The purchaser price p_i^{mt} to be paid for a product i in period mt can now be written as follows:

$$p_i^{mt} = \tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt} p_i^{mt} + \gamma_i^{mt}(\tilde{p}_i^{mt} + \alpha_i^{mt} + \beta_i^{mt}\,\tilde{p}_i^{mt}) \tag{9.2.12}$$

or

$$p_i^{mt} = (\tilde{p}_i^{mt} + \alpha_i^{mt})(1 + \gamma_i^{mt}) + \beta_i^{mt} p_i^{mt}(1 + \gamma_i^{mt}) = \frac{(\tilde{p}_i^{mt} + \alpha_i^{mt})(1 + \gamma_i^{mt})}{1 - \beta_i^{mt}(1 + \gamma_i^{mt})} \tag{9.2.13}$$

Hence, the pre-tax price is:

$$\tilde{p}_i^{mt} = \frac{p_i^{mt}[1 - \beta_i^{mt}(1 + \gamma_i^{mt})]}{1 + \gamma_i^{mt}} - \alpha_i^{mt} \tag{9.2.14}$$

and the 'constant tax rate' price i.e. the (unobservable) price of product i in the comparison period mt which would have appeared if the tax reference period ($0t$) tax rates had been in force, can be calculated as:

$$p_i^{mt}(\tau_i^{0t}) = \frac{(\tilde{p}_i^{mt} + \alpha_i^{0t})(1 + \gamma_i^{0t})}{1 - \beta_i^{0t}(1 + \gamma_i^{0t})} \tag{9.2.15}$$

Given this and using equation (9.2.14), the price relation that reflects the relative price movement of product i from $0t$ to mt is:

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} = \frac{(\tilde{p}_i^{mt} + \alpha_i^{0t})(1 + \gamma_i^{0t})}{1 - \beta_i^{0t}(1 + \gamma_i^{0t})} \Big/ \frac{(\tilde{p}_i^{0t} + \alpha_i^{0t})(1 + \gamma_i^{0t})}{1 - \beta_i^{0t}(1 + \gamma_i^{0t})} = \frac{\tilde{p}_i^{mt} + \alpha_i^{0t}}{\tilde{p}_i^{0t} + \alpha_i^{0t}} \tag{9.2.16}$$

These three cases demonstrate that the relative price movement keeping the price reference period's tax rates constant depends not only on changes in the pre-tax prices, but also on the values of per unit tax rates in the reference period or even on the *ad valorem* tax rate β if it is levied on a price prior to a per unit tax. However, the VAT rate g does not by itself influence the relative price movement with tax rates kept as in the reference period, although it can do so together with other tax rates. The choice of the constant tax reference period is therefore neutral as regards the treatment of VAT, but it matters for the treatment of perunit taxes and sometimes for the treatment of *ad valorem* taxes other than VAT.

The treatment of replacements and quality changes

When product-offers are replaced, possibly with quality adjustment for quality changes (see Chapter 6), the replacement prices should be used in the same way for the index calculation of the HICP-CT as for the HICP.

Forms comprising several years

The HICP-CT is especially relevant for comparing short-term movements with the HICP; it is not primarily designed for long-term comparisons, which can be problematic in both their use and interpretation. The following briefly describes how comparisons can be made over several years.

To provide notation for an annually chained HICP-CT covering time spans of several years, the set of periods per year *t* should comprise 13 months, i.e. 0*t*, 1*t*, …, 12*t*, yielding the annually chained index:

$$CTP^{0(t-h),mt} = \sum_{i=1}^{N_{t-h}} \frac{p_i^{12(t-h)}\left(\tau_i^{0(t-h)}\right)}{p_i^{0(t-h)}\left(\tau_i^{0(t-h)}\right)} \cdot w_i^{0(t-h),t-h-1}$$

$$\sum_{i=1}^{N_{t-h+1}} \frac{p_i^{12(t-h+1)}\left(\tau_i^{0(t-h)}\right)}{p_i^{0(t-h+1)}\left(\tau_i^{0(t-h+1)}\right)} \cdot w_i^{0(t-h+1),t-h} \cdot \ldots \cdot \sum_{i=1}^{N_t} \frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} \cdot w_i^{0t,t-1} \qquad (9.2.17)$$

From the dependence of prices on tax rates, it follows that *chaining effects* in the HICPCT are due not only to annually updated weights, but also to tax rates that have changed. In case 2, per-unit and *ad valorem* tax rates have some impact. In cases 1 and 3, only the former have an impact on the HICPCT.

9.2.5 Examples of different types of tax

The approach described in this chapter involves performing the calculations at the most detailed product level feasible, such as the level of the national average price for a product. The information required for each product *i* is monthly data on:

- product classification (the most detailed product level)

- product description

- price and tax reference period purchaser price (p_i^{0t})

- comparison period purchaser price (p_i^{mt})

- tax rates in reference period and comparison period:

  ○ per-unit taxes ($\alpha_i^{0t}, \alpha_i^{mt}$)

  ○ *ad valorem* taxes ($\beta_i^{0t}, \beta_i^{mt}$) and

  ○ VAT ($\gamma_i^{0t}, \gamma_i^{mt}$) and

- product characteristics relevant for product related taxation (i.e. per unit taxes).

The examples below show how this is done in practice when a VAT rate changes (up and down), when excise duties (per unit and *ad valorem* taxes) change and when a new tax is introduced.

Example 1a: VAT rate goes from 19.6 % to 5.5 %

Product:	Hotel services
Classification code:	11.2.0.1.x.x
Reference period	
… purchaser price p_i^{0t}:	€45.58 (incl. 19.6 % VAT)
Comparison period	
… purchaser price p_i^{mt}:	€50.71 (incl. 5.5 % VAT)

… price index:	111.25
… purchaser price excl. VAT= 50.71×100/105.5	€48.07
… purchaser price incl. original VAT= 48.07×1.196	€57.49
… **CT price index = 57.49/45.58×100:**	**126.12**

As the VAT rate has fallen, the higher CT price index (126.12) compared to the lower price index (111.25) indicates how much higher inflation would have been had the original (high) VAT rate been kept in the sub-index.

Example 1b: VAT rate changes from 7 % to 16 %

Product:	Admission to cultural services /theatres
Classification code:	09.4.2.1.x.x

Reference period (0t)

… purchaser price p_i^{0t}:	€30.50 (incl. 7 % VAT)

Comparison period (mt)

… purchaser price p_i^{mt}:	€33.39 (incl. 16 % VAT)
… price index:	109.48
… purchaser price excl. VAT= 33.39×100/116:	€28.78
… purchaser price incl. original VAT = 28.78×1.07:	€30.80
… **CT price index = 30.80 / 30.50×100:**	**100.98**

As the VAT rate has increased, the lower CT price index (100.98) compared to the higher HICP price index (109.48) indicates how much lower inflation would have been had the original (low) VAT rate been kept in the sub-index.

Example 2: Per unit and *ad valorem* tax increase

All three types of tax are levied on cigarettes in this example, i.e. a per-unit tax, an *ad valorem* tax and VAT (the VAT rate is not changed from the reference to the current period).

Product:	Cigarettes, brand X
Quantity:	40 cigarettes
Classification code:	02.2.0.1.x.x

Reference period (0t)

… purchase price p_i^{0t}:	€7.88 (incl. taxes)

Comparison period (mt)

… purchase price p_i^{mt}:	€10.00 (incl. taxes)
… price index in mt:	126.90

Taxes

… VAT rate in reference and current period:	$\gamma_i^{0t} = \gamma_i^{mt} = 19\ \%$
… Tax per 200 cigarettes in $0t : \alpha_i^{0t} =$	€7.5678

… … for 40 cigarettes =	€1.89195
… Tax per 200 cigarettes in mt; α_i^{mt} =	€8.4578
… … for 40 cigarettes =	€2.11445
… *ad valorem* tax in $0t$: β_i^{0t} =	21.5 %
… *ad valorem* tax in mt; β_i^{mt} =	21.6 %

Pre-tax prices calculated by equation (9.2.4):

Comp. period pre-tax price $\tilde{p}_i^{mt}$ = 10.00/(1.19×1.216) - 2.11445 =	€4.80
Ref. period pre-tax price $\tilde{p}_i^{0t}$ = 7.88/(1.19×1.215) - 1.89195 =	€3.56

CT price index (in comparison period mt):

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} \cdot 100 = \frac{(\tilde{p}_i^{mt} + \alpha_i^{0t})(1 + \gamma_i^{0t})(1 + \beta_i^{0t})}{(\tilde{p}_i^{0t} + \alpha_i^{0t})(1 + \gamma_i^{0t})(1 + \beta_i^{0t})} \cdot 100$$

$$= \frac{\tilde{p}_i^{mt} + \alpha_i^{0t}}{\tilde{p}_i^{0t} + \alpha_i^{0t}} \cdot 100$$

= (4.80+1.89195) / (3.56+1.89195) × 100 =	**122.72**

Hence, the lower perunit and *ad valorem* taxes in the reference period mean that inflation in the comparison period would have been lower (CT price index = 122.72) than is actually the case (HICP price index 126.90).

Example 3: Taxes on energy (unleaded petrol)

Product:	Unleaded petrol 98 octane chain X
Quantity:	10 litres
Classification code:	07.2.2.2.x.x

Reference period ($0t$)

… purchase price p_i^{0t}:	€15.58 (incl. taxes)

Comparison period (mt)

… purchase price p_i^{mt}:	€21.32
… price index in mt:	136.84

Taxes:

… VAT rate in reference and comparison period: γ_i^{0t} = γ_i^{mt} = 16 %	
… Excise duty per 100 litres in $0t$; $\alpha_{1,i}^{0t}$ =	€45.98
… … for 10 litre: 45.98 / 100 × 10 =	€4.598
… Excise duty per 100 litres in mt; $\alpha_{1,i}^{mt}$ =	€84.54
… … for 10 litre: 84.54 / 100 × 10 =	€8.454
… Environmental taxes per 100 litres in $0t$; $\alpha_{2,i}^{0t}$ =	€5.12

… … For 10 litres: 5.12 / 100 × 10 =	€0.512
… Environmental taxes per 100 litres in mt; $\alpha_{2,i}^{mt} =$	€4.62
… … For 10 litre: 4.62 / 100 × 10 =	€0.462

Pre-tax prices calculated by equation (9.2.4):

Comp. period pre-tax price = 21.32/1.16 - 8.454 - 0.462 = €9.46

Ref. period pre-tax price $\tilde{p}_i^{mt}$ = 15.58 / 1.16 – 4.598 – 0.512 =	€8.32

CT price index (in comparison period mt):

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} \cdot 100 = \frac{(\tilde{p}_i^{mt} + \alpha_{1,i}^{0t} + \alpha_{2,i}^{0t})(1 + \gamma_i^{0t})(1 + \beta_i^{0t})}{(\tilde{p}_i^{0t} + \alpha_{1,i}^{0t} + \alpha_{2,i}^{0t})(1 + \gamma_i^{0t})(1 + \beta_i^{0t})} \cdot 100$$

$$= \frac{\tilde{p}_i^{mt} + \alpha_{1,i}^{0t} + \alpha_{2,i}^{0t}}{\tilde{p}_i^{0t} + \alpha_{1,i}^{0t} + \alpha_{2,i}^{0t}} \cdot 100$$

= (9.46 + 4.598 + 0.512) / (8.32 + 4.598 + 0.512) × 100 =	**108.50**

In this example, two per-unit taxes and VAT make up the product taxes. The total direct effect of the tax rate changes is 28.34 index points, i.e. if the reference period's overall lower tax rates had been in force in the comparison period, the index would have been 108.50 instead of 136.84. The example illustrates that the decrease in environmental tax from the reference to the comparison period has only a small impact on the index level as compared with the increase in excise duty (removing this tax would make the CT price index equal 108.13).

Example 4: Introduction of a new tax on energy

A new per unit tax is introduced after the reference month.

Product:	Electricity
Quantity:	10 kWh
Classification code:	04.5.1.x.x

Reference period ($0t$)

… purchase price p_i^{0t}:	€2.10 (incl. taxes)

Comparison period (mt)

… purchase price p_i^{mt}:	€2.30 (incl. taxes)
… price index in mt:	109.52

Taxes

… VAT rate in reference and current period: $\gamma_i^{0t} = \gamma_i^{mt} =$	20 %
… Tax per kWh in $0t$: $\alpha_i^{0t} =$	€0
… … for 10 kWh: 0×10 / 1 =	€0
… Tax per kWh in mt; $\alpha_i^{mt} =$	€0.015
… … for 10 kWh: 0.015×10/1 =	€0.15

Pre-tax prices calculated by equation (9.2.4):

Comp. period pre-tax price $\tilde{p}_i^{mt}$ = 2.30/(1.20) - 0.15 =	€1.7667

Ref. period pre-tax price $\tilde{p}_i^{0t} = 2.10/(1.20) - 0 =$ €1.75

CT price index (in current period) mt:

$$\frac{p_i^{mt}(\tau_i^{0t})}{p_i^{0t}(\tau_i^{0t})} \cdot 100 = \frac{(\tilde{p}_i^{mt} + \alpha_i^{0t})(1 + \gamma_i^{0t})}{(\tilde{p}_i^{0t} + \alpha_i^{0t})(1 + \gamma_i^{0t})} \cdot 100$$

$$= \frac{\tilde{p}_i^{mt} + \alpha_i^{0t}}{\tilde{p}_i^{0t} + \alpha_i^{0t}} \cdot 100$$

$= (1.7667 + 0) / (1.75 + 0) \times 100 =$ **100.95**

Hence, if the tax had not been introduced, inflation in the comparison period would have been lower (CT price index=100.95) than is actually the case (HICP price index 109.52).

9.2.6 Geographical coverage, special aggregates

The geographical coverage of the HICP-CT is the same as that of the HICP.

HICP-CT sub-indices are produced monthly for ECOICOP categories and selected aggregates of ECOICOP classes, including:

GD — goods (overall index excluding services)

FOOD — food including alcohol and tobacco

FOOD_P — processed food including alcohol and tobacco

FOOD_NP — unprocessed food

IGD — industrial goods

IGD_NNRG_D — non-energy industrial goods, durables only

IGD_NNRG_SD — non-energy industrial goods, semi-durables only

IGD_NNRG_ND — non-energy industrial goods, non-durables only

NRG — energy

SERV — services (overall index excluding goods)

9.3 HICP-administered prices

9.3.1 Legal obligations, definitions and concepts

Article 2 of Regulation (EU) 2016/792 contains the following definition:

'(5) "administered prices" means prices that are either directly set or influenced to a significant extent by the government;'

'Laspeyres-type index' and 'basic information', and the rules on index compilation and data requirements in the above Regulation (see Section 9.2.2) are also relevant for the HICP-AP. The above definition of administered prices is particularly relevant to the HICP-AP, as it determines its scope.

9.3.2   Definitions — fully and mainly administered prices

The following definitions apply ([101]):

Fully administered prices are prices of goods and services directly set by government. For example, a government may choose to increase local public transport charges at regular intervals. Other examples may include education fees, theatre tickets, waste collection, childcare and fees for administrative documents, etc.

Mainly administered prices cover prices of goods and services over which government, including any national regulator, has a significant influence, e.g. where price changes require national regulatory authorities' approval/permission. The influence of the national regulator's decisions could be direct (on retail prices) or indirect (via wholesale prices); in any case, the regulator must have a significant influence on the consumer price.

It should be noted that consumer prices subject to indirect taxation and excise duties (e.g. tobacco, petrol) are not classified as 'administered'. The effects of indirect taxes and excise duties are accounted for in the HICP-CT; see Section 9.2.

Explanatory notes on the definitions

In the definition of *mainly administered prices*, the expression '*significant influence*' involves an element of judgement.

'Significant influence' at product level means that prices and/or price developments clearly differ, as a result of the administrative decision, from what they would otherwise have been. For example, the fact that prices need to be approved by government would not necessarily result in significant influence — in this case a judgement has to be made as to whether prices are clearly influenced.

The classification of product categories according to whether their prices are considered fully, mainly or not administered should in principle be undertaken at the lowest possible level of ECOICOP. In practice, prices are currently classified as fully or mainly administered at ECOICOP four-digit class level, while in the future this may be done at five-digit sub-class level when available.

At the ECOICOP level, a rule of 50 % should be applied in two stages. If 50 % or more of the expenditure within a product category at the lowest level is in some way administered (i.e. prices directly set or significantly influenced) by a national regulator, the whole category should be considered administered. At the second stage, if 50 % or more of the administered expenditure is on products for which prices are set directly by government, the whole category should be classified as fully administered. Otherwise, the whole category should be classified as mainly administered.

A few examples of administered prices are mentioned in the above definitions. An example of mainly administered prices in some countries is social rents, which are often subject to public regulation in some form, usually to ensure affordable shelter for some categories of tenant (see Section 12.4). For such rents, increases can be limited to a certain percentage or maximum monetary amount, or made subject to procedures prescribed by law. Rail fares in some countries are controlled in similar ways.

Borderline cases — what to do

In practice, borderline cases occur in the form of product categories where it is not clear whether prices qualify as 'administered'. Judgements have to be made, preferably supported by international experience. These have led to the development of agreed conventions, which are set out in Section 9.3.3.

([101])   See *Supplementary explanations and conventions*, 26 February 2010; http://ec.europa.eu/eurostat

9.3.3   Supplementary explanations and conventions (¹⁰²)

Conventions

The definition of administered prices *covers*:

- price changes approved by government and other national supervisory authorities. This may be the case, in particular, for network industries (e.g. telecommunication services by fixedline providers or postal services) and some insurance prices in some countries; the supervisory authority's decisions must be taken with the explicit objective of influencing consumer prices, even if only indirectly, through changes in producer prices;

- the effects of intentional restrictions on the consumer price level (price caps/price floors); and

- the effects of *permanent* (e.g. long-term) restrictions on consumer price changes.

The definition *does not cover*:

- consumer prices subject to indirect taxation and excise duties (i.e. prices of goods and services with a high indirect tax component, e.g. tobacco, petrol). These are excluded as the effect of change in taxation is reflected in the HICP-CT;

- the effects of product regulation such as safety or environmental standards (e.g. safety standards for cars). These are excluded as their effect on consumer prices is extremely difficult to determine and almost all goods and services are subject to some regulation;

- prices subject to regulations under the EU's common agricultural policy. These mainly have an influence on food products at an intermediate stage, so their impact is very difficult to quantify;

- index-linked prices, unless the reference indicator for linking is an administered price or the index-linking is mandatory and enforced by regulation and law. For example, the linking of rent changes and changes in insurance gross premiums to the overall HICP, CPI or other price indices, or the linking of gas price changes to changes in oil prices, should normally not be considered as involving administered prices, as they are based on contractual agreements aimed at simplifying price adjustments, rather than government control of price changes; and

- the effects of *transitory* restrictions on consumer price changes, i.e. restrictions which are not *permanent* (e.g. restrictions in place in some countries around the time of the euro changeover).

For *telecommunications*, the following conventions have been adopted:

- fixed line and internet services – if binding price regulation exists at the retail level (for at least 50 % of the consumption expenditures), fixed line services should be considered as mainly administered. If price regulation exists only at wholesale level, fixed line and internet services should be classified as non-administered unless there is (quantitative or qualitative) evidence of a dominant impact on prices over several years; and

- mobile services as a whole are considered as non-administered unless there is (quantitative or qualitative) evidence of a dominant impact on prices over several years or regulated termination rates account for over 50 % of operators' total revenues.

For *electricity and gas*, the HICP sub-indices cover a service component (transmission and distribution of electricity/gas) and a commodity component (the electricity and gas itself); the following conventions have been adopted:

- In cases where only the service component falls under the definition of an administered price, the whole sub-index is considered as a non-administered price; and

- In cases where both components fall under the definition of an administered price, the whole sub-index is considered as an administered price.

(¹⁰²)   See *Supplementary explanations and conventions*, 26 February 2010; http://ec.europa.eu/eurostat.

Integrating changes in price administration practices over time into the HICP-AP

Over time, prices that were administered may become deregulated and freemarket prices may become administered. Therefore, the composition of the HICPAP must likewise change over time. It is updated for such changes in the month of January following the changes.

Further comments

The following comments may be added:

- The list of administered prices in force in each Member State is updated annually from Member States' answers to a Eurostat questionnaire;

- When a product category is newly re-classified as administered or as no longer administered, any price change for that category in connection with the reclassification should similarly be considered administered or non-administered;

- Borderline cases between *permanent* and *transitory* restrictions on prices should be resolved by judgement or convention where available;

- Situations can occur where market prices are subject to government restrictions, e.g. in the form of a price cap, price floor or price freeze. Such prices should be considered administered if the restrictions have a significant impact on the prices. Estimating the effect of a cap, floor or freeze on prices can be challenging. For example, if prices are frozen from a given date, to estimate the effect of the measure it would be necessary to compare the resultant price index with a hypothetical price index that would have pertained without the measure. Estimating such hypothetical indices can require some daring judgements and modelling, so such methods have limitations. However, measures of this kind may be of a transitory nature and thus outside the scope of the HICP-AP.

9.3.4   Geographical coverage, special aggregates

The geographical coverage of the HICP-AP is the same as that of the HICP.

For the HICP-AP, the following special aggregates are produced monthly and made available on Eurostat's public database:

AP — administered prices

APF — fully administered prices

APM — mainly administered prices

TOT X AP — overall index excluding administered prices

TOT X APF — overall index excluding fully administered prices

TOT X APM — overall index excluding mainly administered prices

9.3.5   Index calculation

The HICP-AP weights are the same as the corresponding HICP weights and the price indices used are those used in the HICP. However, the HICP-AP contains only those weights and price indices where prices are administered. The HICP-AP index is thus calculated as the weighted aggregate of all ECOICOP indices that are classified as either fully or mainly administered.

The HICP-AP indices are calculated using the same methods as are used for the HICP (see Chapter 8). The monthly aggregation of the HICP-AP to the specified aggregates listed in Section 9.3.4 is performed by Eurostat.

10 Revisions and handling of methodological changes

10.1 Introduction

'Revisions' are any change in the value of a statistic released to the public in printed or electronic form. They are a normal phenomenon leading to an improvement, i.e. an increase in the quality and in particular the accuracy of the data.

In the HICP context, revisions may stem from:

- the implementation of European requirements;

- the introduction of new national methods;

- the inclusion of new or improved basic information;

- the finalisation of provisional figures; or

- the correction of mistakes.

In the interest of users, the number of revisions should be kept to a minimum. Revisions due to the implementation of European requirements should be introduced in a coordinated manner.

Unlike in national accounts, additional basic information for consumer prices may be incorporated in the month after their release, but very rarely after that. The data collection is in general final at the end of the reporting month. This contrasts with national accounts, where revisions are a standard feature reflecting the richer information set that becomes available over time for a given estimate.

The European Statistics Code of Practice ([103]) requires that *revisions follow standard, well-established and transparent procedures*. In this context, Member States (as members of the ESS) are responsible for informing users about their practices on revisions, including the correction of errors. This public declaration promotes confidence among users and accuracy for data producers. Revisions policy should be recognised as an important aspect of good governance in statistics.

Article 7(5) of Regulation (EU) 2016/792 provides that:

> '*Harmonised indices and their sub-indices that have already been published may be revised*.'

The regulation of revisions is unique to the HICP, as other EU statistical domains have revisions policies rather than legal acts.

This chapter describes how and when revisions should take place in the HICP and how revisions and methodological changes should be communicated to the public.

10.2 Legal provisions

Regulation (EC) No 1921/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for revisions of the harmonised index of consumer prices ([104]) sets out detailed rules for the treatment of revisions in the HICP. In addition, Article 9(3) of Regulation (EU) 2016/792 governs the introduction by a Member State of a significant change in its production methods. The provisions are described in the following sections.

([103])   The sixth indicator of the eighth principle of the European Statistics Code of Practice.
([104])   OJ L 261, 29.9.2001. p. 49.

10.3 Definitions

Most of the definitions for HICP revisions are set out in Article 2 of Regulation (EC) No 1921/2001.

Revision: a revision is a change of what has already been published. Article 2(a) states that:

> *'a "revision" is an* ex post *change in a HICP series, index level, rate of change or weight, that has been made publicly available through printed or electronic media by the Commission (Eurostat) affecting the results to one decimal place'.*

Mistakes: a mistake is caused by an error in the recording or processing of data. Article 2(b) states that:

> *'a "mistake" is an unintentional breach of an established rule affecting at least one HICP series'.*

Mistakes are usually made because of errors in basic information or in calculations.

Provisional: a provisional figure or estimate is an initial or first estimate which precedes the final estimate. A provisional figure will be an initial result that is expected to be very close to the finally confirmed figure.

Methodological changes: methodological changes are generally changes in statistical methods, compilation methods, concepts, definitions or classifications. Such changes are normally introduced in a harmonised way according to European guidelines and may occur when new regulations (changes in harmonised rules) enter into force. This chapter also deals with methodological changes at national level that are specific to a given Member State.

Not all changes that take place in the HICP every year are considered as methodological changes; for example, the introduction of new weights or new samples in the context of the yearly update of the HICP are not methodological changes, but part of the regular compilation process.

10.4 Treatment of revisions

10.4.1 Reasons for revisions

Revisions of HICPs may be required for:

a)   the correction of mistakes;

b)   the introduction of new or improved basic information;

c)   a change in methodology; and

d)   the finalisation of provisional figures.

Reason a) would normally lead to an unplanned revision, while reasons b), c) and d) would lead to planned revisions.

Table 10.1 presents the degree to which Eurostat is involved in the event of revisions. Each scenario is discussed in the following sections.

Table 10.1 Revision process — where Eurostat's prior approval is and is not required

Reason for the revision	Eurostat's prior approval required?
Mistakes	No
New information	No; only condition is that Eurostat does not oppose the timing of the revision
Finalisation of provisional figures	No
New national methodologies	Yes
New harmonised rules	Unless otherwise stated, no revision is required.

10.4.2 Revisions for which Eurostat's approval is not required

For the euro area, Eurostat publishes an early or *flash* estimate of selected HICP aggregates, which are based on early estimates of the indices received from euro area Member States (see Chapter 8). The euroarea flash estimates are subsequently replaced by actual indices calculated from the published country data. The replacement of a flash estimate with actual data is not considered a revision in the HICP. However, the actual aggregates may be based on country data that are published as provisional figures and are revised the following month (see section on Article 9 below).

For revisions arising from corrections of errors (unplanned), and the introduction of new or improved basic information, and for publication of the final version of a provisional figure (planned), the prior approval of Eurostat is not required, as described below:

Mistakes (Article 4 of Regulation (EC) No 1921/2001)

Mistakes are usually caused by errors in the calculation of indices. Mistakes are always possible and put serious pressure on the statisticians concerned (e.g. errors in spreadsheet calculations or proof-reading). When discovered, they should be corrected and the relevant series revised. The frequency of revisions due to significant mistakes should be minimised by the use of appropriate quality management and validation procedures. However, errors cannot be avoided completely.

Article 4(1) states that:

> *'Mistakes shall be corrected and resulting revisions shall be implemented without unnecessary delay'.*

Article 4(2) states that:

> *'Member States concerned shall, at their own initiative, provide the Commission (Eurostat) with information at the level of detail necessary to assess the impact on the HICP series concerned before the release of revisions on the grounds of mistakes. The Member States shall also notify the Commission (Eurostat) of the action taken to prevent similar future occurrences'.*

This puts the onus on Member States to:

- correct mistakes as soon as possible;

- to provide Eurostat and users with information on the impact on the series concerned at the same time the revisions are published; and

- also explain what action is being taken to avoid similar errors in future.

New or improved basic information (Article 5)

The incorporation of new or improved basic information differs from the correction of mistakes (Article 4) and the finalisation of HICPs first published as provisional (Article 9), mainly in that the timing of the availability of the information can often be foreseen or even planned.

New or improved basic information for the compilation of HICPs may become available *inter alia* thanks to new and better sources of data, or new basic information, such as information on revenue structures, etc., from public utility (e.g. electricity or water) companies. This new information does not come unexpectedly; it can be planned in the production cycle.

In contrast, very rarely do new input data become available after the HICP estimate is considered final. When this does occur, it is normally in the following month, but very rarely after that. The inclusion of new information and the subsequent revisions this may cause become an issue only if the new or improved information is also available for previous months and not just the latest published figure. Where this is the case, a Member State may decide to revise the backseries, but Eurostat must be consulted and agree to the timing.

The HICP is primarily used as a macroeconomic indicator for monetary policy. It is therefore advisable to revise not only the latest months' data when new information becomes available or new methods are introduced, but also the series for a longer period, e.g. the previous year, which would move the break of the series backward (see Section

10.4.3). The advantage of longer backdata revisions is that the most recent inflation rates, which are important for current monetary policy, are correctly derived from consistent series. Where the HICP is used to index pensions, social benefits and commercial contracts, users should bear in mind that it is open to revision.

Provisional figure (Article 9)

According to Article 9, a figure first published as provisional:

> *'... shall be finalised in the following month's publication'.*

Consequently, entering a provisional figure will entail a planned revision.

In the HICP, price collection is generally considered as *final* at the end of each reporting month, though some late reporting may be taken into account in the next release.

Where data are first published as provisional, the Member State should mark them as such in the transmission to Eurostat. A month later, the figures should either be revised or published as final. Both provisional and revised figures should be clearly marked in all publications (Article 8).

10.4.3 Revisions for which Eurostat's approval is required

Change of harmonised rules (Articles 6 and 7)

Article 6(1) explains that changes in harmonised rules do not require revisions, unless specifically stated in the new regulation. However, Member States are required to assess the impact of such changes for the first 12 months, starting with the index for the January in which the new rules came into effect (Article 6(3)).

Article 6(4) further clarifies that if the *likely* effect on the average annual rate of change in the all-items HICP (i.e. the published inflation rate over the 12-month period) is at least 0.10 pp, Member States are required to estimate the impact on the all-items HICP for each of the 12 months.

In addition, Article 6(5) provides that if the annual rates of change in any ECOICOP division (two-digit), group (three-digit), class (four-digit) or sub-class (five-digit) [105] index are likely to be affected by at least 0.30 pp, 0.40 pp, 0.50 pp or 0.60 pp respectively, the impact on those index series should be estimated in accordance with Article 6(4) for the first 12 months following the introduction of the new rules.

In practice, Article 6(4) and (5) means that, when preparing to apply the new rules, index compilers should estimate the likely impact on the all-items index and the relevant ECOICOP category indices. While not compulsory, it is preferable that these estimates be made prior to the January of introduction. Under Article 7(1), if the application of the new rules is judged likely to have a significant impact on the HICP annual rates of change for which estimates have to be calculated; these estimates should use the best available and most cost-effective methodology. To assess whether a rule change is likely to have a significant impact on the measured rate of inflation, the new rules could be applied to historical data (where possible).

Article 7(2) provides that the impact should be estimated by comparing the annual rates of change of the all-items HICP and relevant sub-indices with indices compiled with the methodologies used before the new rules were introduced.

If the new rules are likely to have a significant impact as defined in Article 6(4) and (5), Article 7(3) requires that impact estimates be made publicly available and that these include an assessment of their quality. It also provides that the estimates should not replace the official HICP series.

Following the implementation of Regulation (EC) No 330/2009 on the treatment of seasonal products, and Regulation (EU) No 1114/2010 on minimum standards for the quality of HICP weightings, Eurostat asked Member States to provide information on the impact on the HICPs of revisions estimated in accordance with Regulation (EC) No 1921/2001. These estimates are available on Eurostat's website.

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[105]   Article 2(21b) of Regulation (EU) 2016/792 extends this treatment to the five-digit sub-class level.

Change of national methodology

However, Member States may choose of their own accord to change their national methodologies to improve the statistical quality of the HICP at any time. In general, however, major changes in methodology are often introduced into the index alongside the updating of samples and weights in January of each year (see Chapters 3 and 8). Where such changes are made, Article 9(3) (*quality assurance*) of Regulation (EU) 2016/792 applies; this states that:

> *'If a Member State intends to introduce a significant change of the production methods of the Harmonised Indices or part thereof, the Member State shall inform the Commission (Eurostat) at the latest three months before any such change would enter into force. The Member State shall provide the Commission (Eurostat) with quantification of the impact of the change'.*

This Article obliges Member States to assess the impact of changes to their national methodologies.

In addition, Article 3(2) of Regulation (EC) No 1921/2001 provides that:

> *'Revisions to any HICP series, other than on the grounds of Articles 4, 5 or 9 of this Regulation, shall be subject to prior approval by the Commission (Eurostat). Their extent and the timing shall be coordinated with the Commission (Eurostat)'.*

As such, Member States are thus obliged to inform Eurostat of any intention they have to change production methods. If a significant change is planned for the following January, Eurostat should be informed no later than September of that year. In parallel, Member States are also required to provide Eurostat with detailed information about the impact of the change in the methodology.

10.4.4 Weights revisions

Regulation (EU) No 1114/2010 sets out minimum standards for the quality of HICP weights to be applied in the calculation of HICPs. In particular, it sets requirements for the annual updating of the HICP weights (see Chapter 3).

Regulation No Article 3(2) states that:

'Each year, Member States shall therefore review and update HICP sub-index weights taking into account preliminary national accounts data on consumption patterns of year t–2 [...] as well as any available and relevant information from household budget surveys and other data sources which are sufficiently reliable for the purposes of the HICP.'

Regulation No 1114/2010 Article 3(5), which gives guidance for the treatment of revisions, states that:

'Any adjustments made to weightings pursuant to this Article shall take effect with the index for January of year t. HICP weights for previous years shall be not revised, without prejudice to the possibility to correct mistakes in accordance with Article 4 of Commission Regulation (EC) No 1921/2001...'.

According to this Article, HICP weights from previous years should not be revised unless a 'mistake' in their calculation is discovered. In particular, HICP weights *should not be revised* as and when new national accounts or HBS data become available, even if they could give rise to an improvement in the weighting system. This is to avoid an undesirable situation in which HICPs are revised repeatedly until underlying national accounts data have become final.

It should be noted that the HICP is different in this respect from the national accounts, where revisions are a standard feature reflecting the richer and more complete datasets that become available for a given quarterly or annual estimate. When new benchmark surveys become available, national accountants systematically revise backseries to reflect the new data. HICP weights should be based on the best available data at the time of their compilation, even if these are subject to planned revision.

Weights for elementary product groups and/or elementary aggregates below the five-digit ECOICOP level should not normally be revised within a year unless an error with a significant effect is discovered; however, it is ultimately for the Member State to decide.

10.5 Practical issues

10.5.1 How to make revisions

It is important that all Member States have well-established and transparent revision policies. The OECD/Eurostat have produced guidance and best practice on revision policy and analysis for sub-annual economic statistics ([106]); this should be the starting point for Member States.

Making a revision involves a number of discrete steps, the nature of which will depend on the reasons for the revision. However, there are a few common steps which are generally necessary to implement a revision. These are described below.

- First of all, for all revisions, Member States should first assess whether a revision is both necessary and possible. Therefore, it should first analyse the impact of changes on the index and then examine the rules applicable to the case;

- Then the Member States concerned, depending on the reason for the revision (see Section 10.4), should, and where required, inform Eurostat beforehand about their decision to revise their data.

- In the next step the main work for the revision takes place. Member States concerned should, where relevant, recalculate the all-items HICP index and the sub-indices for all ECOICOP categories in question for the 12 months prior to the reference period for the year in which the revision takes effect (see Section 10.5.2); and

- Finally, the publication of the revision should be made. HICP revisions should be clearly marked in all publications (Article 8) and should be published in a timely fashion. The revised data should be accompanied by clear and transparent (comprehensible) documentation and complete metadata providing users with detailed information regarding the reasons for the revision. For revisions to all-items HICP, publication should be coordinated with Eurostat.

10.5.2 Impact calculations in the event of methodological changes (Articles 6 and 7)

The introduction of a different or new methodology for HICPs, for example concerning the treatment of seasonal products or the treatment of weights, etc., can significantly affect both the level of price indices and the dynamics of their corresponding monthly and annual rates of change. Users, in particular policymakers in national governments and central banks, need a thorough explanation of the changes resulting from the introduction of a new methodology.

When a methodological change is introduced (normally, but not only, in January), annual rates of change can sometimes be affected by the fact that indices 12 months apart are calculated according to different methods.

Article 7(2) of Regulation (EC) No 1921/2001 gives the following guidance for the calculation of impact estimates:

'The estimates shall compare the annual rates of change of the HICP, and the sub-indices concerned, with an index which does not take account of the changes in definitions, methods or practices.'

There are two methods for calculating these estimates:

- the first method involves undertaking a parallel calculation in the first year of implementation *t*: one calculation that implements the new methodology and one that still uses the old methodology.

   The indices obtained according to the two calculations for the year *t* can be compared with the published indices for the same month of the previous year *t*–1 in order to derive:

([106]) http://www.oecd.org/std/oecdeurostatguidelinesonrevisionspolicyandanalysis.htm

i) the presently published annual rates; and

ii) hypothetical rates that do not implement the related changes required by the new methodology.

The difference between the two rates, which delivers the impact of the new methodology, is given by the formula:

$$Impact = ANR_{mt}^{Published} - ANR_{mt}^{Old\ method} = \left(\frac{i\ mt\ Published}{i\ mt - 1\ Old\ method} - \frac{i\ mt\ Old\ method}{i\ mt - 1\ Old\ method} \right) * 100 \tag{10.4.1}$$

Where

$$ANR_{mt}^{Published}$$

is the published annual rate for month *m* in year *t*; and

$$ANR_{mt}^{Old\ method}$$

is the annual rate that would have resulted for month *m* in year *t* without the implementation of the new calculation method;

- an alternative calculation method could compare the published annual rate for month *m* in year *t* with the annual rate that can be calculated assuming backward implementation of the new methodology and recalculation (revision) of indices for year *t*–1 according to the requirements of the new methodology. The difference between the two rates, which delivers the impact of the new methodology, is given by the formula:

$$Impact = ANR_{mt}^{Published} - ANR_{mt}^{New\ meth.recalc.} = \left(\frac{i\ mt\ Published}{i\ mt - 1\ Old\ method} - \frac{i\ mt\ Published}{i\ mt - 1\ New\ meth.recalc.} \right) * 100 \tag{10.4.2}$$

10.5.3 Timing of revisions (Articles 2, 4, 5 and 9)

The timing of a HICP revision depends on why it has been made.

For revisions arising from the correction of mistakes (Article 4(1)), revisions should be made as soon as possible.

For revisions arising from the use of new or improved basic information (Article 5), the timing is at the discretion of the Member State, on condition that the Commission (Eurostat) does not oppose it. If the revisions are planned in advance, Member States need to decide whether to introduce the new information and revise the HICP in between annual updates of the index or with the index for January. In the former case, it is usually best to concentrate revisions in one month that is announced in advance.

The timing should be coordinated between Eurostat and the Member State concerned (Article 3(2)). A related issue is how far back in time these revisions should go. Data should be revised back as far as is reasonable based on a balancing of user needs, costs and availability of source data. Revisions should be made for a sufficient period of time to give consistent time series. In addition, Article 6(3) requires an assessment of the impact on inflation rates for the first 12 months after introduction.

Under Article 9, revisions arising from the finalisation of an HICP first published as provisional should be done in the month following the publication of the provisional figure.

10.5.4 Measures to be taken to avoid further mistakes

Article 4(2) of Regulation (EC) No 1921/2001 provides that:

'... The Member States shall also notify the Commission (Eurostat) of the action taken to prevent similar future occurrences'

and Article 10 (quality control) provides that:

'In the event of a revision, other than on the grounds of Article 4 or 9, the Member State concerned shall provide the Commission (Eurostat), at its request, with information at the level of detail necessary to assess the impact on the HICP series concerned and demonstrate that the revisions are consistent with the HICP standards'.

This means that when revisions are made to correct mistakes, Member States must provide Eurostat with information about measures they have taken to avoid errors in the future, in order to maintain the integrity of the HICP.

There is not a standard type of measure that Member States should take in order to avoid further errors in the future: the measures taken will depend on the cause of the error in question and they will inevitably vary.

10.5.5 Procedure for publishing a revision

Article 8 (release of revisions) of Regulation (EC) No 1921/2001 provides that:

> 'In the official HICP series released by the Commission (Eurostat), revisions shall be marked. A revision mark shall be assigned to those primary or derived series the results of which, following a revision, have changed at the level of detail released. Revision marks shall be shown on the occasion of the release of the revised series and removed the following month.
>
> Revisions to the all-items HICP, other than to provisional results, shall be publicly announced together with an explanation, in close coordination between the Member State concerned and the Commission (Eurostat).'

Revised data should be accompanied, preferably at the time of publication, by transparent documentation and complete metadata allowing users to understand the reasons for the revisions. As a minimum, the documentation should cover:

- the reasons for the revision (changed methodology, improved basic information or a mistake) and the method used to correct the data or details of the new methodology;

- for new methodology, the estimated impact on the sub-indices affected by the change and on the all-items HICP; and

- an estimate of the impact on the annual inflation rates and the carry-over effect on the current year.

Before indices resulting from a planned methodological change are published, users should be made aware of the change, the reason for it and its likely impact for future indices and rates of change. If the changes are significant, they should be pre-announced. In particular, key users (central banks, finance ministries, etc.) should be alerted in advance of all planned major methodological revisions to help them to prepare and to understand better the reasons for and the nature of the changes.

The Member State can include the pre-announcement in its monthly publication or issue a dedicated press/website release.

11

Data requirements and processes at Eurostat

11.1 Introduction

Eurostat releases HICP data via various media twice a month. Around the middle of the month, the preceding month's HICP for the individual countries and European aggregates are released. The mid-month release includes the full dataset of the most recent HICPs (the standard HICP, special aggregates and the HICP-CT). At the end of each month, Eurostat releases a flash estimate of the euro area HICP for that month (along with selected special aggregates). These data are made available through Eurostat's dissemination database and tables, presented in *Statistics Explained* articles and distributed widely as news releases. They are sent to DG ECFIN and to the ECB for use in policymaking. Other institutional and private sector users retrieve them directly from the dissemination database [107].

Before their release, HICP input data are processed at Eurostat; they undergo successive steps of validation, computation and preparation for publication. Eurostat also collects, produces and makes available a range of metadata on the HICP [108].

The full HICP dataset includes the indices and weights for individual countries and European aggregates (i.e. country-group indices for the EU, the euro area and the European Economic Area (EEA)). These data are provided for aggregates for the hierarchical categories of the ECOICOP (see Chapter 2) and a series of special aggregates. The special aggregates are derived from the ECOICOP indices by combining them thematically (see Annex 11.1). Eurostat produces the European and special aggregates from the ECOICOP indices and weights provided by the Member States.

This chapter presents how Eurostat produces HICP data and metadata, and describes the process from data transmission to the release of the indices.

11.2 Legal obligations

Regulation (EU) 2016/792 sets out requirements for the provision of data relevant to the HICP. Article 3(1) states that:

> *'Member States shall provide the Commission (Eurostat) with the harmonised indices as defined in point (12) of Article 2.'*

Article 2(12) defines the harmonised indices:

> *'"harmonised indices" means the HICP, the HICP-CT, the OOH price index and the HPI;'*

Thus, Member States are thus required to transmit the HICP and HICP-CT indices to Eurostat. Regulation (EU) 2016/792 also contains the following provisions:

- The index reference period is defined in Article 5(5):

    > *'The common index reference period for the harmonised indices shall be 2015. That index reference period shall be used for the full time series of all harmonised indices and their sub-indices.'*

- For cases where transmission of sub-indices is voluntary, Article 5(7a) applies:

    > *'Member States shall not be required to produce and transmit:*
    >
    > *(a) sub-indices of the HICP and of the HICP-CT accounting for less than one part in a thousand of the total expenditure;'*

- For sub-indices which are part of the ECOICOP classification, but are not included in the coverage of the HICP, Article 5(8) applies (see Chapter 2):

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[107] http://ec.europa.eu/eurostat/data/database
[108] http://ec.europa.eu/eurostat/web/hicp/metadata

'Member States shall not be required to produce the following sub-indices of ECOICOP, either because they are not included in the household final monetary consumption expenditure or because the degree of methodological harmonisation is not yet sufficient:

02.3   Narcotics;

09.4.3   Games of chance;

12.2   Prostitution;

12.5.1   Life insurance;

12.6.1   FISIM.'

- The frequency of HICP indices is stated in Article 6(1):

   'Member States shall provide the Commission (Eurostat) with the HICP, the HICP-CT and their respective sub-indices at monthly intervals, including those sub-indices produced at longer intervals.'

- The provision of annual updated weights is specified in Article 6(4):

   'Each year, Member States shall provide the Commission (Eurostat) with updated sub-index weights for the harmonised indices.'

- The data transmission deadlines for the indices are stated in Article 7(1a):

   'Member States shall provide the Commission (Eurostat) with the harmonised indices and all sub-indices by no later than:

   (a) 15 calendar days, for the February to December indices, and 20 calendar days, for the January indices, after the end of the month for which the indices are calculated; …'

- For weights, Article 7(2a) states that:

   'Member States shall provide the Commission (Eurostat) with the updated weights by no later than:

   (a) 13 February each year for the monthly indices;'

- For flash estimates, Article 7(3) states that:

   'Member States whose currency is the euro shall provide the Commission (Eurostat) with the flash estimate of the HICP no later than the penultimate calendar day of the month to which the flash estimate refers.'

- The standards to be used for data and metadata transmissions are referred to in Article 7(4):

   'Member States shall provide the Commission (Eurostat) with the data and metadata required by this Regulation in accordance with data and metadata exchange standards.'

- Article 7(5) makes it clear that HICP indices can be revised (see Chapter 10):

   'Harmonised indices and their sub-indices that have already been published may be revised'.

11.3 Input data for the HICP

Most of the input data required to produce and publish the HICP come directly from Member State statistical departments responsible for consumer price indices. Some necessary additional input data, such as purchasing power parities (PPPs) for producing the country weights and fuel prices for estimating missing data for flash estimates, are taken from other sources.

Member States send the following data to Eurostat according to a pre-determined timetable:

- *HICP and HICP-CT:* these are produced and transmitted monthly for all relevant ECOICOP categories. They refer to the common reference year 2015. The exception is new sub-indices if their series do not cover the year 2015. When integrated into the HICP, they are linked into the HICP in December of a preceding year at the level of 100 index points and published from the following January onwards;

- *HICP flash estimates (HICP-FE):* euro area Member States send either the full set of ECOICOP indices or selected special aggregates (all-items, food, processed food, unprocessed food, industrial goods excluding energy, energy, electricity and gas, fuels, and services). Only euro area countries are required to send HICP-FE data;

- *National ECOICOP category weights (two to five-digit level):* Member States send these annually for all ECOICOP categories for which they produce an HICP;

- *Complementary data for deriving country weights:* Member States also provide Eurostat with annual estimates of *income in kind* and *administrative charges of private pension funds and the like*, which are part of 'individual consumption expenditure by households' but do not fall within the scope of the HICP. These expenditure categories are not identified separately in the ECOICOP expenditure data and thus need to be deducted from the expenditures (see Section 11.4.6); and

- *Administered prices definitions:* each year, Member States send an update of their list of ECOICOP indices that are classified as either fully or mainly administered (see Chapter 9).

Member States transmit their data files using Eurostat's single data entry point system, EDAMIS (electronic data files administration and management information system). The use of EDAMIS is compulsory for the transmission of all regular ESS datasets to Eurostat. Data are transmitted using a secure channel, traffic records are kept and the EDAMIS system sends notifications automatically to senders and recipients when files arrive. EDAMIS also sends automatic reminders to the senders before the expected data transmission. EDAMIS is installed in all Member States that provide Eurostat with HICP data. Eurostat also uses it to send data to the Member States, if needed and to the ECB and DG ECFIN.

Detailed technical requirements for the data files and their transmission are set out in the HICP data transmission guide. Eurostat continuously updates the guide, which is sent to all data suppliers. The guide shows which data flows are currently active for the HICP domain. It gives the conventions used for naming the files, along with the required data format. It also lists what additional information must be included in each file and for each transmitted record, how to code the records, etc. The files can be sent to Eurostat under embargo by adding a date and time before which the data must not be released.

In practice, each transmitted index and weight file contains information for a single period (month, quarter or year). Files can consist of any number of lines, each of which contains information about a single observation (index, inflation rate, weight, etc.) or embargo for a given period. Member States may flag the records they send to indicate to Eurostat and users that they differ from the regular data. In the HICP domain, there are five flags in use (see Table 11.1).

Table 11.1 Flags used in the country transmissions of HICP data

Flag	Title	Use
'p'	Provisional	Used when it is known that the data are likely to be revised with the subsequent transmission.
'd'	Definition differs	Used when the index or weight is not compiled fully following the set standards; or, in the case of the accession and candidate countries, if Eurostat has not made a thorough assessment of the conformity of the country's HICP with the HICP standards.
'e'	Estimated	Used when data were not compiled according to the normal process, but using statistical modelling; typically used for HICP-FE.
'c'	Confidential	Used when a Member State does not give permission to publish the data.
'r'	Revised	Used when previously transmitted data are changed.

The 'c' flag is changed to colons (':') in publications to indicate that the data are not available.

To complement the HICP data, Eurostat collects and publishes a set of metadata on the HICP. Member States update the structured SDMX-compliant metadata annually using a web-based tool provided by Eurostat.

11.3.1 Transmission of indices

Around the middle of each month, Member States transmit to Eurostat a full set of national HICP and HICP-CT indices for all hierarchical levels of ECOICOP. Thus the files transmitted each month include an index value for all ECOICOP categories from the lowest level (five-digit sub-class) up to the all-items index that a given Member State produces. For the HICP-FE, the euroarea countries send a data file towards the end of each month, consisting of either the full set of detailed ECOICOP indices or, if this is not possible, a set of selected special aggregates as defined in the data transmission guide.

The transmitted index sets must be consistent in aggregation, i.e. aggregate correctly from the lowest level to the highest all-items level when combined with the ECOICOP category weights which Member States provide at the beginning of each year.

The indices are provided with the same number of decimal places as Member States use in their own production process, so that Eurostat can re-compute the aggregation from the lowest ECOICOP level indices up to the highest. By convention, Eurostat publishes the national hierarchical HICP and HICP-CT as aggregated and published by Member States. However, it calculates the special aggregates itself.

All indices are sent monthly with the index reference period 2015, with the exception of index series that start later than December 2014, which are to be transmitted based on the previous December. In principle, starting with a January index, Member States may adjust the set of indices they send to Eurostat by adding new sub-indices that have become relevant in the country or dropping sub-indices that have become obsolete and are therefore no longer produced.

For the HICP-FE, Eurostat uses the indices transmitted by Member States, but (where country data are missing) also price data for petroleum products taken from DG ENERGY's *Weekly Oil Bulletin*. Also, if a Member State has not delivered the index data file on time for the publication of the HICP-FE, Eurostat produces an estimated index set using a SARIMA model for the country in question. The estimated indices are used to compute the aggregates, but are not published.

11.3.2 Transmission of ECOICOP category weights

The ECOICOP category weights as supplied by each Member State are used directly, without adjustment, to calculate the European and special aggregates for the HICP, HICP-CT, HICP-FE and HICP-AP. Thus, only one set of weights is used throughout the HICP domain.

Every February, Member States transmit a new set of HICP weights for all ECOICOP categories or positions for which they will be producing an index in the current year. The weights are applied to the indices for January to December of the current year. As the official deadline for transmitting the new weights is after the release date for the January HICP-FE, the euro area Member States are asked to transmit in December, on a voluntary basis, preliminary weights to be used for the January HICP-FE.

The weights are sent with the same number of decimal places as Member States use in their national HICP aggregation. They are given as parts per thousand and the sum of weights from lower levels has to aggregate correctly to those from the higher levels. The all-items (ECOICOP 00) weight has to equal exactly 1 000.

Member States do not always have to produce all the lowest level ECOICOP indices. This is allowed in the case where the weights below a threshold of one part per thousand. In such cases, the agreed approach is that positive, but below threshold weights are distributed within an ECOICOP class proportionally among products with above threshold weights (see Chapter 3).

11.3.3 Country weights

In addition to ECOICOP category weights, Eurostat needs country weights in order to establish the European aggregates (see Table 11.2). These are calculated by Eurostat, not transmitted by the Member States. For all these aggregates, each country gets a weight that corresponds to its share of consumption expenditure in the total of the group.

11.3.4 Administered prices (HICP-AP)

The HICP-APs are specific indices that are produced by Eurostat on the basis of the classification of the ECOICOP indices (degree of price administration) provided by the Member States (see Chapter 9).

For the calculation of HICP-AP aggregates, Member States provide Eurostat annually with information as to which categories of ECOICOP are administered, and to what extent. Changes to the HICP-AP classification that are relevant to the HICP are included in the compilation of the HICP-AP indices with the index for January; the classification is not changed within the year. The HICP-AP classification by Member States [109] is published on Eurostat's website. Countries are asked to provide the relevant metadata for all classification changes in a file covering the following:

* ECOICOP categories affected by the change;

* the classification of categories as fully, mainly or not administered;

* the approximate share of the administered prices within an ECOICOP category;

* the start/end date of price regulation for each ECOICOP category classified as administered or mainly administered;

* a list of the sub-indices that are administered; and

* reasons for classification changes: e.g. new regulation, etc.

11.3.5 Transmission deadlines and publication calendar

The legal deadlines for the transmission to Eurostat of the HICP, HICP-CT and HICP-FE indices and the ECOICOP category weights are set out in Regulation (EU) 2016/792 (see Section 11.2). For other datasets, such as the HICP-AP classification and preliminary HICP-FE weights data, Eurostat establishes deadlines in cooperation with the Member States. It expects to receive the data by 11.00 CET on the day of the agreed deadline.

Regulation (EU) 2016/792 requires Member States to provide Eurostat with the February to December HICP and HICP-CT indices no later than 15 calendar days after the end of the reference month; for the January indices, the period is 20 calendar days after the reference month. For the HICP-FE, the euro area Member States have to send the indices no later than the penultimate calendar day of the month.

For the ECOICOP category weights, the annual deadline is 13 February. Eurostat asks the euro area countries that are able to provide preliminary weights for the January HICP-FE calculation to send these data a few days before the index delivery deadline, so that they can be processed before the index calculation.

For the HICP-AP, the annual update for the classification of ECOICOP product categories at four-digit class level as fully, mainly or not administered is normally requested each December, with a deadline of end-January for providing information on any changes to the classification.

For the February to December indices of each year, Eurostat's target is to publish the complete set of HICP and HICP-CT indices two working days after the transmission deadline, which is about 17 calendar days after the end of the reference month. The publication of the January index is normally scheduled five working days after the data delivery deadline, i.e. on or around 25 February.

The HICP-FE publication target is the day following the data delivery deadline. Eurostat aims to release the HICP-FE on the last working day of the month, with the exception of that for December, for which the publication date is the beginning of January.

The exact HICP publication calendar [110], which takes into account the deadlines given in Regulation (EU) 2016/792, weekends and public holidays, is presented each autumn to the Price Statistics Working Group for agreement and published on Eurostat's website.

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[109] http://ec.europa.eu/eurostat/web/hicp/methodology/hicp-administered-prices

[110] http://ec.europa.eu/eurostat/news/release-calendar

11.3.6 Data validation

Member States validate their data files using their own data quality checks before transmitting them to Eurostat. Regardless of any checks by the Member States, Eurostat subjects all incoming data files to a set of structure and content validation steps.

As regards the index files, in addition to the structural validation, Eurostat checks:

- that index values are provided for all ECOICOP categories/positions which have a non-null (zero) weight;

- that each index value is the result of the aggregation of its constituent lower level ECOICOP index values;

- that index values are within a reasonable prediction range. The one-step-ahead prediction is done using a SARIMA model integrated into the FAME production system. Values with extreme changes are further inspected visually and if necessary with Demetra+ to judge whether the Member State should be asked to verify the change;

- whether there are any gaps in the full time series;

- whether an index value is the same as in the previous month; and

- that the HICP and HICP-CT data are consistent, i.e. that the rates of change in the two indices can differ only if there has been a tax change. The comparison further informs the judgement as to whether extreme HICP values are plausible.

As regards the weights files, in addition to the structural validation, Eurostat checks:

- that the total weight is 1 000;

- whether there are missing or null (zero) values;

- the additivity of the weights, e.g. the weight of ECOICOP 07 should be the sum of its sub-categories ECOICOP 071, 072 and 073, etc.; and

- for significant differences from the previous year.

The results of Eurostat's validation are sent to the Member States for final verification. If it appears that there have been errors in the structure or the content of a file, the Member State is asked to return a corrected file to Eurostat. Once the file passes all validation checks, the data are uploaded to Eurostat's production database and they are ready to be disseminated and used in the computation of the special and European aggregates.

11.4 Index calculation at Eurostat

Eurostat's index calculation system uses the indices and ECOICOP weights reported by Member States, complemented with country weights calculated by Eurostat. All data are aggregated according to the ECOICOP classification (see Chapters 2 and 3).

On the basis of these three sets of data (indices, ECOICOP category weights and country weights), Eurostat computes the following monthly indices:

- The European aggregates — these cover all countries in each group for which all standard sub-indices and special aggregates are calculated. Eurostat produces two types of European aggregate:

  o those that have changing country composition over time, i.e. euro area and EU aggregates that refer to country compositions at a specific point in time; and

  o those that have fixed country composition over the whole series (see Table 11.3 and Annex 11.2);

- The special aggregates at country and European levels — these are combinations of specific ECOICOP classes; and

- The HICP-AP aggregates — these differ from the other special aggregates in that their compositions vary depending on the country and over time.

All index calculations are performed with unrounded data and the resulting indices are rounded to one or two decimal places depending on national practice. All European aggregates are published with two decimal places. As Eurostat uses unrounded data in the aggregation, users cannot exactly replicate the results using the published rounded data.

In addition to the monthly index aggregation, Eurostat calculates a set of average indices and rates of change (see Table 11.5).

In Eurostat's production process, the special and European aggregates are compiled as outlined (a weighted average of unchained indices at each level of ECOICOP), using the formulas presented in Chapter 8. The country indices (index reference year 2015) are first unchained and the aggregates are computed from these unchained time series using appropriate country and ECOICOP category weights. As the resulting aggregates series are also unchained, thus they need to be chained back to form longer time series and referenced to the index reference year.

The computation of the unchained index values for a given year from a chained index requires the index value for December of the previous year.

For HICP-AP aggregates, the ECOICOP category compositions can change over the years, but the computation as such is the same as for fixed-composition special aggregates.

Chart 11.1: Computation of special and the European aggregates at Eurostat
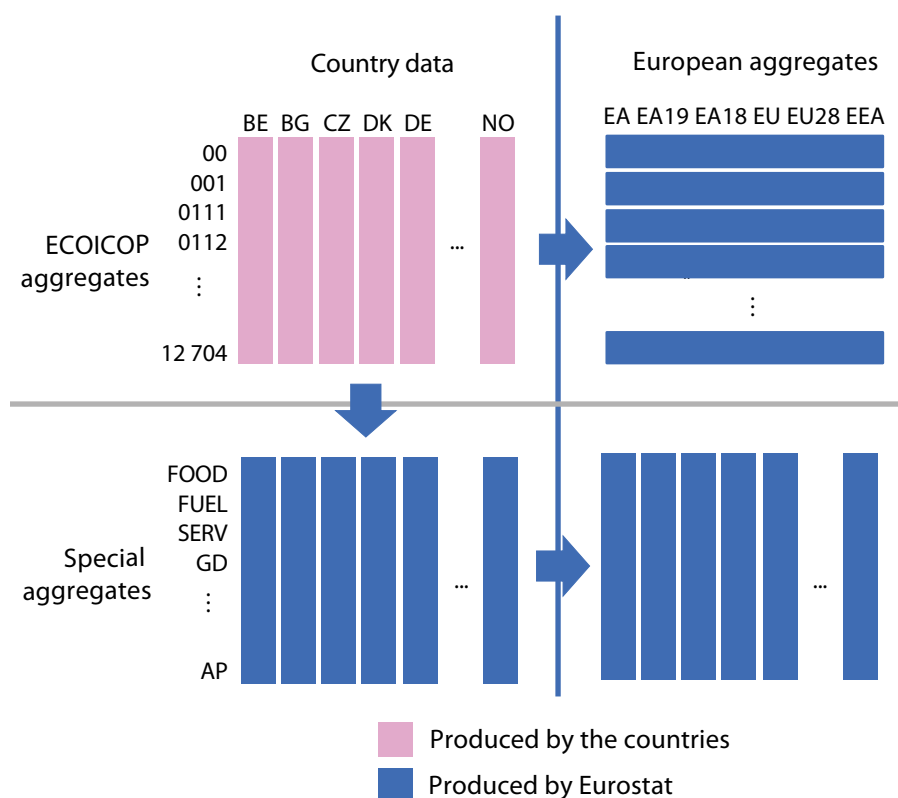
11.4.1 European aggregates

The changing composition European aggregates (the euro area, EU and EEA indices) are computed on the basis of the relevant country compositions at a specific point in time. New countries are integrated into the aggregates using a chain index formula. Annex 11.2 shows how the compositions change over time. The fixed composition aggregates have the same country composition throughout the index series.

The aggregates are calculated as a weighted average of the unchained indices of the countries belonging to the European aggregate. The weights used in the aggregation are computed every year to reflect each country's share of expenditure in the EU, euro area or EEA total. The calculation for the EU and the EEA aggregates includes the euro area as a single entity.

On the basis of indices provided by the countries (or the special aggregates it has computed for each country), Eurostat computes the European aggregates grouping several countries.

Table 11.2: European aggregates

Aggregate	Acronym	Composition	Use	Notes:
Euro area	EA	Changing composition	Official euro area aggregate	Provides the index of the countries that were euro area members at any specific point in time
Euro area 19	EA19	Fixed composition	Published for analytical purposes	All current euro area Member States
Euro area 18	EA18	Fixed composition	Published for analytical purposes; will be phased out at the beginning of 2018	EA19 without Lithuania
European Union	EU	Changing composition	Official EU aggregate	All Member States at any given point in time
European Union 28	EU28	Fixed composition	Published for analytical purposes	All current Member States
European Economic Area	EEA	Changing composition	Official EEA aggregate ([111])	The EU + Norway and Iceland

New Member States are integrated into the aggregates using a chain index formula. When the composition changes in the short-term index reference month December, the standard computation presented in Chapter 8 applies. However, if the composition of the European aggregates changes in the course of a year (e.g. when Croatia joined the EU in July 2013), the year is split into two parts, before and after the change, and chaining is performed in the middle of the year. The aggregate for the first part of the year (from January to the month preceding the month of change) is computed in the usual way. For the months after month m of the composition change, it is computed on indices referenced to (m-1). The second part of the year is considered as a *new year*. This operation requires a technical price-updating of the ECOICOP category weights from the Dec t–1 weight/price reference to the new link month, thus establishing new country weights. As a result, there are two sets of weights within one year.

11.4.2 Special aggregates

Special aggregates are computed by Eurostat, but also by some Member States.

On the basis of indices provided by Member States, Eurostat computes special aggregates by aggregating/grouping several sub-indices together (e.g. the 'unprocessed food' special aggregate regroups the sub-indices 0112, 0113, 0116 and 0117).

([111])   Liechtenstein does not provide an HICP.

With the exception of HICP-AP, the compositions of the special aggregates are fixed over time and over countries, provided that a country is producing all of the sub-indices for the special aggregate in question.

There are two possible ways of computing European special aggregate indices:

1. computation from countries' special aggregates; or

2. computation from the ECOICOP indices of European aggregates.

In theory, both options lead to exactly the same results, except where some figures are not available. Eurostat computes the European special aggregates according to option 1.

11.4.3 HICP flash estimate

The HICP-FE for the euro area is based on early national HICP data, combined with model-based estimates of missing data. The HICP-FE gives an early indication of what the euro area HICP is likely to be when the full dataset is available.

The HICP-FE is computed from the following input information:

- preliminary indices that are provided by all euro area Member States. The availability of these indices varies according to country: some countries produce only the preliminary all-items index, some produce some of the special aggregates and others produce the full ECOICOP breakdown;

- HICP backdata time series; and

- energy price data from the *Weekly Oil Bulletin* on DG ENER's website [112]. The estimates use prices for petrol, diesel and heating oil.

HICP-FE is produced only for the total euro area (changing composition) and for the following aggregates:

- all-items HICP (CP00);

- food, alcohol & tobacco (FOOD)

    o   processed food including alcohol and tobacco (FOOD_P);

    o   unprocessed food (FOOD_NP);

- energy (NRG);

- non-energy industrial goods (IGD_NNRG);

- services (SERV);

- overall index excluding energy (TOT_X_NRG);

- overall index excluding energy and unprocessed food (TOT_X_NRG_FOOD_NP); and

- overall index excluding energy, food, alcohol and tobacco (TOT_X_NRG_FOOD).

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[112]   http://ec.europa.eu/energy/en/statistics/weekly-oil-bulletin

11.4.4 ECOICOP category weights

Member States produce ECOICOP weights at all levels of the classification once a year. A Member State is not obliged to produce indices and weights for every ECOICOP category (although it may choose to do so) if expenditure on the category represents less one part per thousand of its total household final monetary consumption expenditure compiled according to the HICP concept (see Chapter 2 and Section 11.2).

11.4.5 Calculation of country weights

The country weights are calculated at Eurostat in cooperation with the Member States. They are produced annually, for use from January of each year.

In the calculation of the country weights, Eurostat uses, as inputs, national accounts expenditure data, purchasing power parities (PPPs), the HICP data and the irrevocable euro conversion rates ([113]) (if necessary). These data are taken from sources available at Eurostat. As the national accounts expenditure data are not detailed enough to enable all necessary adjustments to achieve complete adherence to the HICP concepts, Eurostat asks the Member States for complementary information on expenditures that fall outside the scope/coverage of the HICP (see Chapter 2) and thus have to be deducted from the expenditure data, but which do not have a specific ECOICOP category.

The national accounts aggregate that is used as the starting point in the country weights calculation is 'individual consumption expenditure by households', in national currency units, adjusted for HICP coverage and (for non-euro area countries) PPP exchange rates. Eurostat uses t–2 expenditures for the country weights, i.e. for expenditures referring to 2017, the country weights are derived from the 2015 national accounts figures.

In the first step of the country weights calculation, the following six expenditure categories, which fall outside the coverage of the HICP, are deducted from 'individual consumption expenditure by households':

1. narcotics (02.3.0.0);

2. imputed rentals for housing (04.2.0.0);

3. games of chance (09.4.3.0);

4. prostitution (12.2.0.0);

5. life insurance (12.5.1.0); and

6. FISIM (financial intermediation services, indirectly measured (FISIM) (12.6.1.0).

In addition, *net purchases abroad* (13.0.0.0), i.e. purchases by resident households outside the economic territory of the country less purchases by non-residential households in the economic territory of the country, is deducted from the total so that the data correctly reflect the domestic concept of the HICP (see Chapter 2).

To complete the transformation of the data from 'individual consumption expenditure by households' to 'household final monetary consumption expenditure', two positions that are not individual ECOICOP classes have to be deducted, so the Member States are asked to provide an estimate for them. At the same time, the Member States are asked to verify the expenditure data to be used in the country data calculation. The two positions for which Eurostat requests data are:

1. income in kind, such as free food for employees in agriculture and final consumption that does not involve monetary transactions (e.g. consumption of own-account production of goods); and

2. administrative charges of private pension funds and the like (part of ECOICOP 12.6.2). Although monetary transactions, these do not fall within the HICP coverage (see Chapter 2).

([113]) Where the expenditure data are not yet expressed in euro, but in the previous national currency; the irrevocable euro conversion rates are normally needed, but only for the first year after a country has joined the euro area.

Table 11.3: Adjustments to 'individual consumption expenditure by households' data

Individual consumption expenditure by households:
minus:
narcotics;
imputed rentals for housing;
games of chance;
prostitution;
life insurance;
FISIM;
income in kind;
administrative charges of private pension funds and the like; and net purchases abroad;
= household final monetary consumption expenditure, domestic concept (in national currency)

To derive the country weights from total household final monetary consumption expenditure, the figures are price-updated to December $t–1$ using the all-items HICP. Also, in order to be able to sum up the country values have to be expressed in the same currency. For the euro area aggregate, the country weights are calculated on the basis of the Member States' expenditures expressed in euro. For the non-euro countries in the EU and the EEA aggregates, the common currency unit is the purchasing power standard (PPS). The country final monetary consumption expenditure figures are converted to euros using the EU28 PPS based on the PPPs for household final consumption expenditure (e011) from $t–2$. In the EU and EEA aggregates, the euro area is included as one *country* using price-updated total euro area final monetary consumption expenditure as its weight. This means that, in all European aggregates, the euro area indices are always aggregated using the same relative country weights derived from the expenditure data expressed in euro.

The country weights for the fixed composition European aggregates are established in a similar way.

Table 11.4 Country weights datasets in the dissemination database

Code	Label
COWEU	Country weights for European Union (EC12-1994, EU15-2004, EU25-2006, EU27-2013, EU28)
COWEU28	Country weights for EU-28 (European Union)
COWEA	Country weights for the euro area (EA11-2000, EA12-2006, EA13-2007, EA15-2008, EA16-2010, EA17-2013, EA18)
COWEA19	Country weights for EA19 (Euro area)
COWEA18	Country weights for EA18 (Euro area)
COWEEA	Country weights for EEA (European Economic Area)

11.4.6 Derived statistics

Eurostat also produces a number of derived statistics that are calculated from published monthly indices.

All rates of change (inflation rates) are computed from the published, rounded indices, with the exception of the United Kingdom, for which the rates are derived from unpublished, unrounded indices. All rates of change are rounded to one decimal place for publication (see Section 8.5).

The following rates of change are calculated:

- monthly rate of change (rate of change compared with previous month);
- annual rate of change (rate of change compared with same month of previous year);
- moving 12-month average rate of change; and

- annual average rate of change for years (rate of change of the annual average compared with previous year). The annual average rate of change is not calculated from rounded published annual average indices, but from *unrounded unpublished* monthly indices (see Section 8.5.4).

Eurostat also computes impacts on inflation. Impact is defined as a measure showing the changes in inflation due to the inclusion of a sub-index. The impact takes account of both the weight and whether the inflation for that sub-index is higher or lower than the all-items inflation rate. Currently, Eurostat disseminates only the subset of the three biggest and three smallest impact figures as part of the news release of current HICPs.

11.5 Publication of HICP data and metadata

Eurostat provides HICP data free of charge via the Eurostat website ([114]) to facilitate access by a wide range of users and further processing of the information. Generally, Eurostat data and other content may be freely re-used, including for commercial purposes, subject to the conditions set out on the website.

In line with the European Statistics Code of Practice ([115]), Eurostat disseminates the HICP on its website respecting professional independence and in an objective, and transparent manner with all users treated equitably. Detailed arrangements for pre-release access to the HICP are given in the Eurostat protocol on impartial access to Eurostat data for users ([116]).

11.5.1 Dissemination database

The HICP data are released twice a month according to a pre-announced schedule. The complete set of the previous month's HICP data is released around the middle of the month and the HICP-FE for the euro area as a whole is released on the last working day of the month or shortly after.

The data are released at 11.00 CET, which in the case of the mid-month HICP release is two working days after the transmission deadline, and in the case of the HICP-FE one day after the transmission deadline. The HICP news releases are published simultaneously with the data.

The HICP data and reference metadata are published in a dissemination database ([117]) that is accessible via Eurostat's website. The HICP can be found in three parts of the database's hierarchical structure: *database by themes, tables by themes* and *tables on EU policy*. The data are identical in all three sections.

The *database by themes* contains the full range of HICPs disseminated by Eurostat, presented as multi-dimensional tables with full breakdowns and complete time series. The data browser used is Data Explorer, which offers direct access to data, metadata and several export formats. The HICP data can be found in the 'economy and finance' section under 'prices'.

The *tables by themes,* and *tables on EU policy* show selected HICP data in a simple way, presented as two or three-dimensional tables derived from the above-mentioned multidimensional tables. The data browser allows for the display of the data using graphs and maps. In the *tables on EU policy*, the HICP is included in the 'euro indicators/ Principal European Economic Indicators section under the *Consumer prices* tab.

The dataset comprises 32 countries and six European aggregates giving price indices, annual average price indices, monthly and annual rates of change, and moving 12-month rates of change. None of the data are seasonally adjusted.

In addition to the all-items HICPs, 131 sub-indices for different goods and services are made available for the HICP and HICP-CT. These data are complemented with 37 special aggregates. Also, in the HICP series there are six HICP-AP special aggregates.

([114]) http://ec.europa.eu/eurostat/data/database

([115]) http://ec.europa.eu/eurostat/c/portal/layout?p_l_id=64173&p_v_l_s_g_id=0

([116]) http://ec.europa.eu/eurostat/documents/4187653/5798057/IMPARTIAL_ACCESS_2014_JAN-EN.PDF/1f1ffb9b-046d-4c47-94fd-f5ff001d7381

([117]) http://ec.europa.eu/eurostat/data/database

The HICP-FE data are included in the tables with HICP indices, annual rates of change and monthly rates of change. The data consist of the all-items figure and nine special aggregates. The HICP-FE data are overwritten with the actual HICP data when they are released.

Also, the weights for the full range of indices, including the special aggregates, are made available for the individual countries and for all country groups.

Table 11.5: **HICP data in the** *database by themes*

Database code	Description	Periodicity
prc_hicp_midx	HICP indices	Monthly
prc_hicp_manr	HICP annual rates of change	Monthly
prc_hicp_mmor	HICP monthly rates of change	Monthly
prc_hicp_mv12r	HICP 12-month average rates of change	Monthly
prc_hicp_aind	HICP annual averages and rates of change	Annual
prc_hicp_cow	Country weights	Annual
prc_hicp_inw	ECOICOP category weights (aka item weights)	Annual
prc_hicp_fp	HICP indices as first published	Monthly
prc_hicp_cind	CT indices	Monthly
prc_hicp_cann	CT annual rates of change	Monthly
prc_hicp_cmon	CT monthly rates of change	Monthly

The indices are currently disseminated with 2015 as the index reference year. With the exception of index series that end before 2015. Those data are referenced to 2005 where possible or, if the 2005 data are also missing, to 1996. If the series do not cover any of those years, the data are shown with the reference period with which they were originally transmitted to Eurostat.

In addition, Eurostat publishes the HICP index series with the reference years 2005=100 and 1996=100 for users who need data based on those previously used index reference years. The HICP series of these two previous reference years are derived (rescaled/re-referenced) from the 2015-based indices using all decimal places. All inflation rates are calculated from the 2015=100 data. The data are included in the HICP table 'prc_hicp_midx', in which the reference year 2015, 2005 or 1996 can be selected in the *Unit* tab. The index reference year 2015 is set as the default.

The HICP is a revisable index, so data that have already been published may be changed in the database. In particular, the HICP data release may include some provisional data for the latest month. These are usually confirmed as final figures, or revised, the following month. Other, major revisions are normally released with explanatory notes in the press release. Also, substantial changes in methodology are described in the first release of data affected by them (see Chapter 10).

In the monthly HICP update, new data are added and the existing data are overwritten with any revised data. Changes compared with the previous update are flagged with 'r' only for a short period, generally until the next update. The unrevised HICP data, as first published on the day of the most recent HICP release, are available in the HICP table 'prc_hicp_fp'. The table contains data for all geographical entities, the complete set of indices with reference years 2015=100, 2005=100 and 1996=100, and the HICP annual rates.

All datasets can be downloaded using the standard data extraction tools on the Eurostat website.

The published indices for individual countries are rounded to either one or two decimal places, in line with national practices. The released indices of European aggregates are rounded to two decimals. The monthly and annual inflation rates are calculated from these index levels and subsequently rounded to one decimal place for publication. This ensures that the published inflation rates match the corresponding released indices. The disseminated ECOICOP category and country weights are rounded to two decimals.

Table 11.6: Rounding of the published indices

Published rounded to two decimal places	Published rounded to one decimal place
AT, BE, BG, CY, ES, EE, FI, FR, EL, HR, HU, IS, LT, LU, LV, MT, NL, PT, RO, SK, SI, SE, TR	CH, CZ, DE, DK, UK, IE, IT, NO, PL
EA, EA19, EU, EU28, EEA	

11.5.2 HICP news releases

The news releases are the most visible example of HICP data dissemination. They rank highest in terms of policy relevance and regularly attract comprehensive media coverage.

HICP news releases are published twice per month in English, French and German on the Eurostat website and are sent directly by email to journalists who have subscribed to that service.

The releases are issued at 11.00 CET on the pre-determined dates. They are provisionally pre-announced in the Eurostat release calendar, which notifies releases up to 12 months ahead. A final calendar is issued each Friday for the following week.

11.5.3 HICP metadata and other documents

The HICP data are complemented by a comprehensive set of reference metadata, explanatory notes, other reference documents and statistical articles. All information and data are accessible via the dedicated HICP section [118] on Eurostat's website.

The HICP reference metadata [119] is compiled by the Member States and Eurostat following the Euro-SDMX metadata structure and comprises information *inter alia* on concepts and definitions, data coverage, periodicity, compilation practices and procedures, revisions, data quality and release policy. Other metadata (e.g. keywords, footnotes or flags linked to a code list) are directly attached to a value in the Eurostat dissemination database. In addition, Eurostat's Reference Architecture for Metadata Online (RAMON) [120] application is used for the dissemination of various additional categories of metadata (e.g. classifications, concepts and definitions, standard code lists, legal acts, methodological manuals and glossaries). RAMON includes the COICOP/HICP classification (which shows, in particular, the currently used special aggregates) [121] and ECOICOP [122] classification in all official EU languages with detailed descriptions.

[118] http://ec.europa.eu/eurostat/web/hicp/overview

[119] http://ec.europa.eu/eurostat/web/hicp/methodology/metadata-and-national-practices

[120] http://ec.europa.eu/eurostat/ramon/index.cfm?TargetUrl=DSP_PUB_WELC

[121] http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_ DTL&StrNom=HICP_2000&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC

[122] http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_ DTL&StrNom=COICOP_5&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC

Annex 11.1: Special aggregates definitions

Special aggregate	Description	Composition
EDUC_HLTH_SPR	Education, health and social protection	06, 10, 124
ELC_GAS	Electricity, gas, solid fuels and heat energy	0451, 0452, 0454, 0455
FOOD	Food including alcohol and tobacco	FOOD_P, FOOD_NP
FOOD_NP	Unprocessed food	0112, 0113, 0116, 0117
FOOD_P_X_ALC	Processed food excluding alcohol	0111, 0114, 0115, 0118, 0119, 0121, 0122
FOOD_P_X_TBC	Processed food excluding tobacco	0111, 0114, 0115, 0118, 0119, 0121, 0122, 0211, 0212, 0213
FOOD_P	Processed food including alcohol and tobacco	FOOD_P_X_ALC, 0211, 0212, 0213, 022
FOOD_S	Seasonal food	0113, 0116, 0117
FROOPP	Frequent out-of-pocket purchases	0111, 0112, 0113, 0114, 0115, 0116, 0117, 0118, 0119, 0121, 0122, 0211, 0212, 0213, 022, 0314, 0561, 0562, 0941, 0942, 0951, 0952, 1111, 1112, 1211, 1212_3, 0611, 081, 0914, 0935, 0953_4, 0722, 0724, 0731, 0732, 0735
FUEL	Liquid fuels and fuels and lubricants for personal transport equipment	0453, 0722
GD	Goods (overall index excluding services)	FOOD, IGD
IGD	Industrial goods	IGD_NNRG, NRG
IGD_NNRG	Non-energy industrial goods	IGD_NNRG_ND, IGD_NNRG_SD, IGD_NNRG_D
IGD_NNRG_D	Non-energy industrial goods, durables only	0511, 0512, 0531_2, 0711, 0712_34, 0911, 0912, 0913, 0921_2, 1231
IGD_NNRG_ND	Non-energy industrial goods, non-durables only	0441, 0611, 0612_3, 0431, 0561, 0933, 0935, 0952, 0953_4, 1212_3
IGD_NNRG_SD	Non-energy industrial goods, semi-durables only	0311, 0312, 0313, 032, 052, 054, 055, 0721, 0914, 0931, 0932, 0951, 1232
NRG	Energy	ELC_GAS, FUEL
NRG_FOOD_NP	Energy and unprocessed food	0112, 0113, 0116, 0117, 0451, 0452, 0453, 0454, 0455, 0722
NRG_FOOD_S	Energy and seasonal food	NRG, FOOD_S
SERV	Services	SERV_REC, SERV_TRA, SERV_HOUS, SERV_COM, SERV_MSC
SERV_COM	Services related to communication	081, 08x
SERV_HOUS	Services related to housing	041, 0432, 0442, 0443, 0444, 0513, 0533, 0562, 1252
SERV_MSC	Services — miscellaneous	0621_3, 0622, 063, 10, 124, 1253, 1255, 126, 127
SERV_REC	Services related to recreation, including repairs and personal care	SERV_REC_HOA, SERV_REC_X_HOA
SERV_REC_HOA	Services related to package holidays and accommodation	096, 112
SERV_REC_X_HOA	Services related to recreation and personal care, excluding package holidays and accommodation	0314, 0915, 0923, 0941, 0942, 1111, 1112, 1211
SERV_TRA	Services related to transport	0723, 0724, 0731, 0732, 0733, 0734, 0735, 0736, 1254

TOT_X_ALC_TBC	Overall index excluding alcohol and tobacco	00 without 02
TOT_X_EDUC_HLTH_SPR	Overall index excluding education, health and social protection	00 without EDUC_HLTH_SPR
TOT_X_FOOD_S	Overall index excluding seasonal food	00 without FOOD_S
TOT_X_FROOPP	Overall index excluding frequent out-of-pocket purchases	00 without FROOPP
TOT_X_FUEL	Overall index excluding liquid fuels and lubricants for personal transport equipment	00 without FUEL
TOT_X_HOUS	Overall index excluding housing, water, electricity, gas and other fuels	00 without 04
TOT_X_NRG	Overall index excluding energy	00 without NRG
TOT_X_NRG_FOOD	Overall index excluding energy, food, alcohol and tobacco	00 without NRG and FOOD
TOT_X_NRG_FOOD_NP	Overall index excluding energy and unprocessed food	00 without NRG_FOOD_NP
TOT_X_NRG_FOOD_S	Overall index excluding energy and seasonal food	00 without NRG_FOOD_S
TOT_X_TBC	Overall index excluding tobacco	00 without 022
AP	Administered prices	Composition changing across time
APF	Fully administered prices	Composition changing across time
APM	Mainly administered prices	Composition changing across time
TOT_X_AP	Overall index excluding administered prices	00 without AP — Composition changing across time
TOT_X_APF	Overall index excluding fully administered prices	00 without APF — Composition changing across time
TOT_X_APM	Overall index excluding mainly administered prices	00 without APM — Composition changing across time

Annex 11.2: Compositions of European aggregates

The following table describes the European aggregates and their composition across time.

European aggregate	Description	From	To	Composition
EA	Euro area		Dec-2000	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI
		Jan-2001	Dec-2006	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL
		Jan-2007	Dec-2007	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI
		Jan-2008	Dec-2008	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI, CY, MT
		Jan-2009	Dec-2010	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI, CY, MT, SK
		Jan-2011	Dec-2013	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI, CY, MT, SK, EE
		Jan-2014	Dec-2014	BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI, CY, MT, SK, EE, LV
		Jan-2015		BE, DE, FR, IT, LU, NL, IE, ES, AT, PT, FI, EL, SI, CY, MT, SK, EE, LV, LT
EA18	Euro area (18 countries)			BE, DE, FR, IT, LU, NL, IE, EL, ES, AT, PT, FI, SI, CY, MT, SK, EE, LV
EA19	Euro area (19 countries)			BE, DE, FR, IT, LU, NL, IE, EL, ES, AT, PT, FI, SI, CY, MT, SK, EE, LV, LT
EU	European Union		Dec-1994	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT
		Jan-1995	Apr-2004	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE
		May-2004	Dec-2006	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI
		Jan-2007	Jun-2013	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI, BG, RO
		Jul-2013		BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI, BG, RO, HR
EU28	European Union (28 countries)			BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI, BG, RO, HR
EEA	European Economic; Area		Apr-2004	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, IS, NO
		May-2004	Dec-2006	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, IS, NO, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI
		Jan-2007	Jun-2013	BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, IS, NO, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI, BG, RO
		Jul-2013		BE, DE, FR, IT, LU, NL, DK, IE, UK, EL, ES, PT, AT, FI, SE, IS, NO, CY, CZ, EE, HU, LT, LV, MT, PL, SK, SI, BG, RO, HR

Annex 11.3: Country codes

Code	Country	Code	Country
BE	Belgium	PL	Poland
BG	Bulgaria	PT	Portugal
CZ	Czech Republic	RO	Romania
DK	Denmark	SI	Slovenia
DE	Germany	SK	Slovakia
EE	Estonia	FI	Finland
IE	Ireland	SE	Sweden
EL	Greece	UK	United Kingdom
ES	Spain		
FR	France	IS	Iceland
HR	Croatia	NO	Norway
IT	Italy	CH	Switzerland
CY	Cyprus		
LV	Latvia	MK	F.Y.R.O. Macedonia
LT	Lithuania	ME	Montenegro
LU	Luxembourg	RS	Serbia
HU	Hungary	TR	Turkey
MT	Malta		
NL	Netherlands	US	United States of America
AT	Austria	JP	Japan

12

The treatment of
selected product groups

This chapter provides methodological guidance for selected product groups that present particular challenges to index compilers. Moreover, guidance on using scanner data to compile HICPs is available on the Eurostat web site ([123]).

The product groups included are:

- 12.1 Health, education and social protection services
- 12.2 Insurance services
- 12.3 Purchase of motor vehicles
- 12.4 Actual rentals
- 12.5 Air fares and package holidays
- 12.6 Telecommunication services
- 12.7 Clothing and footwear
- 12.8 Financial services
- 12.9 Electronic goods

12.1 Health, education and social protection services

12.1.1 Introduction

Expenditures on the health, education and social protection sectors of the economy account for a large proportion of total economic activity in many Member States. One distinctive feature of these services is that their provision is often funded by the state or by non-profit institutions serving households (NPISHs). In some cases they may be offered without explicitly charging the household or, alternatively, they may be partially subsidised or not subsidised at all, which means that the household must pay the partial or full cost of the service.

Council Regulation (EC) No 2166/1999 is unambiguous on the HICP's treatment of goods and services in the health, education and social protection fields. Generally, if expenditure is incurred by a household for these products, then it should be covered in the HICP, otherwise, it is out of scope.

Although household expenditures for products from the health, education and social protection fields are conceptually within the scope of the HICP, estimating their weight and price development can pose many methodological challenges for the compiler.

Cases exist in the health, education and social protection sectors that require *special* treatment. Education services is an example where tuition fees sometimes include products that would normally be allocated to other expenditure categories of the HICP classification structure (e.g. educational books, accommodation) but, for practical reasons, are sometimes not.

Regulation (EC) No 2166/1999 is in place to ensure that Member States apply a common methodology when faced with such situations, thus improving the international comparability of the HICP.

However, even with such a Regulation in place, there are no assurances that it will always be interpreted and applied consistently across Member States. For example, Annex 12.1.1 summarises a case in the Netherlands following major reforms of the healthcare system in 2006. The changes were so far-reaching that questions were raised about how,

([123]) Practical guide for processing supermarket scanner data, Eurostat, 2017

under the current regulatory framework, the effects of the reforms could be accounted for when compiling the HICP. The recommendations that stemmed from these events in the Netherlands are discussed in that section.

For an introductory overview of the methodological and conceptual issues relating to compiling price indices in the health, education and social protection services fields, see paragraphs 3.9-3.11 of the *ILO Consumer Price Index Manual: Theory and Practice* (2004). *The Practical Guide to Producing Consumer Price Indices* (2009), section 9.3, also covers the topic of health, education and social protection services in relation to consumer price indices (CPIs) in general.

12.1.2 Legal requirements of the HICP

The treatment of health, education and social protection products in the HICP is governed by Regulation (EC) No 2166/1999 of 8 October 1999 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of products in the health, education and social protection sectors in the Harmonised Index of Consumer Prices [124].

The coverage of health, education and social protection products in the HICP is laid down in Article 3:

1. *Goods and services in the health, education and social protection sectors on which household final monetary consumption expenditure is incurred shall be covered in the HICP and grouped in accordance with the COICOP/HICP categories as laid down in Commission Regulation (EC) No 2214/96.*

2. *All providers of goods and services in the health, education and social protection sectors, such as government and private institutions, NPISHs or private self-employed persons, shall be covered in the HICP independently of their status. This excludes individuals or groups of individuals as producers of goods and non-financial services exclusively for own final use.*

3. *In accordance with COICOP/HICP, Education (Division 10) includes education services only. If an all-inclusive price is charged for education services in combination with educational materials or education support services, its components shall be separated and allocated to the COICOP/HICP classes concerned. Where such an all-inclusive price cannot be separated into the prices of the components concerned, the all-inclusive price shall be allocated to COICOP/HICP Division 10.*

4. *Borderline cases between education services at the pre-primary level and child-minding social protection facilities, such as wet-nurses, crèches and play-schools, shall be allocated to COICOP/HICP Division 10 if the child's age of entry is not less than three years and the activities consist of organised instruction in a school-type environment designed to bridge the gap between the home and school atmosphere. If, on the other hand, the main objective is not a pedagogical one, but to provide child-minding assistance and support, the service concerned should be allocated to COICOP/HICP class 12.4.0.*

5. *Where hospitals, in addition to basic services as defined in COICOP/HICP 06.3, make other goods or services available to in-patients on a separate charge basis, the latter shall not be allocated to class 06.3.0, but to the COICOP/HICP classes concerned.*

The sample of prices to be used when compiling the indices for products consumed in health, education and social protection sectors is described in Article 4:

1. *The HICP sub-indices concerned shall be calculated using a formula which is consistent with the Laspeyres-type formula used for other sub-indices. They should reflect the price change on the basis of the changed expenditure of maintaining the consumption pattern of households and the composition of the consumer population in the base or reference period.*

2. *(a) The purchaser prices of goods and services in the health, education and social protection sectors to be used in the HICP shall be the amounts to be paid by consumers net of reimbursements.*

   (b) Changes in purchaser prices which reflect changes in the rules determining them shall be shown as price changes in the HICP.

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[124] OJ L 266, 14.10.1999, p. 1.

(c) *Where purchaser prices are index-linked, changes resulting from changes in the index shall be shown as price changes in the HICP.*

(d) *Changes in the purchaser prices resulting from changes in purchasers' incomes shall be shown as price changes in the HICP.*

3. *Where quality changes, prices should be treated according to the rules applied in the context of specification changes, and in particular those regarding quality adjustment pursuant to Article 5 of Commission Regulation (EC) No 1749/96.*

4. *Where goods and services, in the health, education and social protection sectors, have been made available to consumers free of charge and subsequently an actual price is charged, the change from zero to an actual price, and vice versa, shall be reflected in the HICP.*

5. *Where goods or services in the health, education and social protection sectors, jointly provided with other goods and services, have been made available to consumers free of charge and subsequently are charged for on a separate basis, the change shall be reflected in the HICP.*

6. *Where relevant, the procedure provided for in Article 5 of Commission Regulation (EC) No 2646/98 concerning tariffs shall apply mutatis mutandis* [with the necessary changes having been carried out].

The rules for the basic information requirements and the data sources for compiling the indices for health, education and social protection services are outlined in Articles 5 and 6, respectively.

On basic information, Article 5 states that:

The basic information shall be all purchaser prices of goods and services in the health, education and social protection sectors and their components, together with weightings which reflect the level, the timing and the structure of the consumption of such goods or services, according to the price-determining socio-economic characteristics.

The data sources for compiling the HICP in the areas of health, education and social protection services are outlined in Article 6:

1. *The HICP sub-indices concerned shall be computed by the Member States from basic information as defined in Article 5.*

2. *The statistical units, such as government agencies, social administrations or NPISHs, called upon by the Member States to cooperate in the collection or provision of basic information are obliged to give honest and complete information at the time it is requested and allow the organisations and institutions responsible for compiling official statistics, on request, to obtain information at the level of detail necessary to evaluate compliance with the comparability requirements and the quality of the HICP sub-indices.*

12.1.3 Definitions and concepts

Articles 2 and 4 of Regulation No 2166/1999 contain the following definitions on the treatment of products in these sectors:

Reimbursements refer to payments to households by government units, social security administrations or non-profit institutions serving households, that are made as direct consequence of purchases of individually specified goods and services, initially paid for by households.

Payments of claims to households by insurance companies do not constitute reimbursements.

Purchaser prices of goods and services in the health, education and social protection sectors to be used in the HICP shall be the amounts to be paid by consumers net of reimbursements.

Other payments or rebates to households by government units, social security administrations or non-profit institutions serving households 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 considered as social benefits in cash. They are treated as income transfers to households and do not constitute reimbursements.

The complementary terms and definitions below, relating to health, education and social protection, will also be used in this section. Although these definitions are not explicitly included in Regulation (EC) No 2166/1999, they are still useful for the reader.

Social expenditures [social protection] are a measure of the extent to which countries assume responsibility for supporting the standard of living of disadvantaged or vulnerable groups. Social spending comprises cash benefits, direct in-kind provision of goods and services, and tax breaks with social purposes. Benefits may be targeted at low-income households, the elderly, disabled, sick, unemployed or young persons. To be considered 'social', programmes have to involve either redistribution of resources across households or compulsory participation ([125]).

Income-dependent prices are prices for which their level is a function of household income. In other words, high-income families typically pay more for the product compared to low-income families and there is usually a maximum and a minimum fee.

12.1.4 Classification and coverage

12.1.4.1 Classification

In ECOICOP, health, education and social protection expenditures are classified as follows:

06 HEALTH

Includes:

Health services purchased from school and university health centres.

06.1 Medical products, appliances and equipment

06.1.1 Pharmaceutical products

06.1.1.0 Pharmaceutical products

06.1.2 Other medical products

06.1.2.1 Pregnancy tests and mechanical contraceptive devices

06.1.2.9 Other medical products n.e.c.

06.1.3 Therapeutic appliances and equipment

06.1.3.1 Corrective eye-glasses and contact lenses

06.1.3.2 Hearing aids

06.1.3.3 Repair of therapeutic appliances and equipment

06.1.3.9 Other therapeutic appliances and equipment

06.2 Out-patient services

06.2.1 Medical services

06.2.1.1 General practice

06.2.1.2 Specialist practice

06.2.2 Dental services

06.2.2.0 Dental services

([125]) From https://data.oecd.org/socialexp/social-spending.htm

06.2.3 Paramedical services

    06.2.3.1 Services of medical analysis laboratories and X-ray centres

    06.2.3.2 Thermal-baths, corrective-gymnastic therapy, ambulance services and hire of therapeutic equipment

    06.2.3.9 Other paramedical services

06.3 Hospital services

06.3.0 Hospital services

    06.3.0.0 Hospital services

10 EDUCATION

10.1 Pre-primary and primary education

10.1.0 Pre-primary and primary education

    10.1.0.1 Pre-primary education

    10.1.0.2 Primary education

10.2 Secondary education

10.2.0 Secondary education

    10.2.0.0 Secondary education

10.3 Post-secondary non-tertiary education

10.3.0 Post secondary non-tertiary education

    10.3.0.0 Post secondary non-tertiary education

10.4 Tertiary education

10.4.0 Tertiary education

    10.4.0.0 Tertiary education

10.5 Education not definable by level

10.5.0 Education not definable by level

    10.5.0.0 Education not definable by level

12.4 SOCIAL PROTECTION

12.4.0 Social protection

    12.4.0.1 Childcare services

    12.4.0.2 Retirement homes for elderly persons and residences for disabled persons

    12.4.0.3 Services to maintain people in their private homes

    12.4.0.4 Counselling

12.1.4.2 Coverage

On coverage, Regulation (EC) No 2166/1999 Article 3(1) is clear — transactions that involve expenditure by a household in the health, education and social protection services sectors are in scope and should be covered in the HICP. This approach is consistent with the concept of household final monetary consumption expenditure; see Chapter 2 — HICP Concepts.

In many countries, the services produced by the health, education and social protection sectors are delivered by government or non-profit institutions serving households, and no explicit fee is charged to households. In other words, although a household may consume these services, their provision is financed by the tax or social security system.

In such cases, the consumption (and cost of producing) these particular goods and services should not be included in the HICP, an approach which is consistent with the household final monetary consumption expenditure concept. However, should the household have to subsequently pay for the product, it then falls within the scope of the HICP, including for the period that it was offered for free. This is because, under the Regulation, price changes that go from nil to a positive value should be reflected in the HICP (see Article 4 of the Regulation (set out in Section 12.1.5 above) and Section 7.5).

Although the regulatory framework is relatively straightforward to comply with and apply, a number of special cases can often be encountered in the normal course of compiling the HICP.

For example, with childcare systems where the government partially subsidises the full cost of providing the service, it is the *net* (or purchaser) price paid by the household that is covered by the HICP and that should be included under the proper elementary aggregate (or elementary product group) entry in the classification system. This is regardless of whether the childcare service is run privately or publicly.

The same Regulation excludes, however, services produced by the household. These are categorised as 'own consumption' and so do not involve a monetary transaction. For example, in the case of home schooling, although a service is consumed by some members of the household, it is also being produced by the same household so this service is excluded from the HICP. This approach is consistent with the conceptual basis of the national accounts, where, according to paragraph 1.37(a) of the European System of National and Regional Accounts (ESA 2010), domestic and personal services produced and consumed within the same household fall outside the production boundary and should not be recorded in the ESA.

There should be consistency between the conceptual basis on which the weights are compiled and the range of products from which prices are to be collected for the HICP. Both should respect the scope of the HICP. For partially subsidised goods and services in the health, education and social protection sectors, expenditures incurred by the household should be the basis for calculating the weights. For example, if the public healthcare system pays for 75 % of a medical device such as a hearing aid, then only the remaining 25 % of the cost, which the household would be required to pay out of pocket, would be within the scope of the HICP and included in the index's weighting scheme.

Article 3(3) of Regulation No 2166/1999 deals with the treatment of education. ECOICOP 10 (Education) should exclude expenditures that are often ancillary to education but not defined as an education service. Examples of such goods and services are healthcare services (06), transport services (07.3), books (09.5.1), stationery (09.5.4), catering services (11.1.2), and accommodation services (11.2.0). Expenditures on these non-education products should, in principle, be allocated to their respective areas of the ECOICOP.

For example, some higher education institutions, such as universities, may promote or advertise to current and prospective students, in addition to their tuition fees, the estimated ancillary costs, such as room and board rates. Products under ECOICOP 10 should be limited to the tuition and enrolment fees only.

If an all-inclusive price is charged that covers more than just the education service, such as room and board costs, then it becomes a bundled service. The acceptable procedure for treating such services in the HICP (see Section 7.6) is, where possible, to separate each of the bundle's constituent components and allocate them to their appropriate ECOICOP class.

Article 2(4) of Regulation (EC) No 2166/1999 offers some clarity on the treatment of borderline cases where there may be confusion as to how to best classify primary education services and the social protection service of child-minding and nurseries. Both types of service cater for children of the same age group (typically three to six years of age but can vary depending on the country) but their functions differ.

Many institutions that cater for children in this age group offer a service that can be qualified as educational in nature. Here the child is in an early childhood education setting and is being prepared for the start of compulsory education at primary school. In such cases, the activity should be classified under class ECOICOP Division 10.

By contrast, if little in terms of a pre-school educational environment is offered, then the service being provided is more appropriately described as 'childcare services', which should be allocated to social protection (ECOICOP class 12.4.0). Methodological issues may also arise if the institution offers in the course of e.g. 1 week, both types of services to the child. Here, the price statistician will need to determine, usually after consulting with the institution, if its primary function is more educational in nature or more day care.

It should be remembered, however, that as with any borderline case, it is often worth exploring how the situation is treated in the national accounts. The weighting structure of the HICP is based on national accounts and the attribution of price observations and weights should be consistent. We recommend that the distribution of the weights and the classification of the observed prices are always consistent – possibly after some discussion and negotiation between national accounts and HICP specialists.

A case in point is the treatment in the HICP of what are recognised as being *voluntary contributions* by households, often to private schools, that appear to gaining in popularity in some Member States. These types of contributions are excluded from the HICP, because, as for the national accounts, they are considered to be transfers.

Article 2(5) of Regulation No 2166/1999 deals with healthcare and more specifically with the case of hospitals that, in addition to basic services as defined in ECOICOP/HICP 06.3, provide other goods or services for in-patients on a separate charge basis. These additional services should not be allocated to class 06.3.0, but to the relevant ECOICOP category.

For example, a patient who has spent a number of days in a hospital after a medical procedure may not have to pay for their treatment since the cost is covered by the public healthcare system. If, however, during their stay, the patient rented a TV or a phone, these extra charges should be allocated, according to Regulation, to the proper class (e.g. the rental fee for a TV would be allocated to ECOICOP (09.4.2.4)).

12.1.5 Prices

The sample of prices to be used when compiling the indices for health, education and social protection services is regulated according to paragraphs (a) and (d) of Article 4 of Regulation (EC) No 2166/1999, see 12.1.2.

12.1.5.1 Purchaser prices

Article 4(a) of Regulation No 2166/1999 stipulates that if a household must pay for a good or service provided by the health, education and social protection sectors, the price that is recorded for the purposes of the HICP should be the purchaser price (i.e. the amount paid by the consumer minus any reimbursements they may receive).

Note that the nature of the payment will play a role in determining what constitutes the purchaser price. For example, only those payments to households by government units, social security administrations or non-profit institutions serving households, which are made as a direct consequence of purchases of individually specified goods and services in the education, health and social security sectors, will be considered when estimating the purchaser price. Only these are to be considered as reimbursements. Payments from an insurance company for a claim made by a household are not taken into consideration, as they are not considered as reimbursements according to Article 2(2) of Regulation No 2166/1999. In such cases, the full market price is included in the index calculation according to Article 3(2) of Regulation 1617/1999 (see also Section 12.2.)

Other types of payments or rebates by government units, social security administrations or non-profit institutions serving households that provide a form of assistance to (lower-income) households are considered social benefits or transfers in kind and do not qualify as reimbursements and are not used to calculate the purchaser price. Examples include housing allowances to low-income tenants and scholarships to students.

To estimate the expenditure weight for a product for which a reimbursement as described above is likely, it is important that the price statistician has access to a data source that contains this information. National accounts data on household consumption expenditures can be a relevant source of information, since its scope follows the same purchaser price principle set out in the Regulation. On the other hand, if the household budget survey is

used as the source of detailed weights in this sector, it is important that the questions in the household budget survey are properly formulated so that the respondent provides information to qualify the expenditures (i.e. the expenditures after the qualified reimbursement is deducted), otherwise the data will need to be adjusted. A potential source of information on the amount of reimbursements to execute this task would be the authority with the responsibility for managing the reimbursements to the households.

12.1.5.2 Changes in rules, income-dependent prices and index-linked prices

Under Regulation (EC) No 2166/1999, Article 4, paragraphs 2(b), (c) and (d), a change in a purchaser price for a product in the health, education and social protection sectors should be recorded in the HICP if it results from a change in government policy, the uprating index used for the specified product (i.e. an index-linked price) or from the consumers' income level.

Article 4(2)(b) deals with situations where a change in policy or a regulation affects purchaser prices. Such price changes should be reflected in the HICP.

At times, certain charges and fees to households for the price paid for goods and services in the health, education and social security sectors are linked to a price index, for example a country's HICP (or CPI). Article 4(2)(c) covers the effect of changes to the index used for determining changes to the purchaser price of an index-linked product in the health, education and social protection sectors.

Index-linking a purchaser price gives these types of fee increases, which are usually applied at a pre-set date once a year, an element of transparency. For example, it could be that a Member State has adopted a policy where all changes to tuition fees are tied and limited to the national rate of inflation or a wage index. If this is the case, then any increase in these fees resulting from a movement in the chosen index is considered a legitimate price increase in the HICP according to the Regulation.

For prescribed medicines, if there are no legislative changes to a reimbursement policy, an accurate price index for this product can be estimated simply by sampling the posted prices.

However, if public authorities decide to change the policy governing reimbursements, this is likely to affect the purchaser price. Price level changes resulting from a change in the reimbursement policy should be reflected in the HICP. Estimating the relevant price is not always easy as it is rarely, if ever, directly observable.

If the list price differs from the purchaser price, the latter will need to be determined to reflect how the change in the amount of the reimbursement has affected the true or actual amount paid by the household once the amount of the settlement is accounted for. To accomplish this, some information will need to be obtained from a third party source on the rules and conditions for reimbursement and the allowable amounts of any claims. This source is usually the health authorities or the entity responsible for administering the reimbursements. In some cases, publicly available *official* price lists may exist for these products which may include the net price after reimbursement.

Example: How to account in the HICP for a change in reimbursement rules

The reimbursement for a given drug has fallen to €10 in period t from the previous level of €20 in period t–1.

Assuming that you can obtain information on the market price from a pharmacist during the regular field collection exercise, the net price paid for the drug by the household, once the reimbursement is accounted for, now stands at €90 in period t; this compares to the out-of-pocket price of €80 previously paid at t–1.

*The reimbursement amount fell in period t, leading to a **higher net price** of €90, on average.*

*The estimated price index for the drug is estimated at **112.5** (=€90/€80-1 x 100), owing to the change in policy.*

Sometimes there may be hesitation about the correct treatment if the government-sponsored portion of a service (e.g. childcare services) can be provided in two ways: either in the form of a direct price subsidy to the provider or as a reimbursement in the form of a tax credit to the household. Does it make a difference for the HICP? As an example of a change in a rule and its treatment in the HICP, assume that the public authorities partially offset the full cost of attending university by offering subsidised tuition for students whose household income is below a certain pre-

defined threshold. In a subsequent period, the authorities decide to raise this threshold. Consequently, household income must now be higher to qualify for subsidised tuition fees.

Because of this policy change, certain segments of the population that previously had access to the subsidised tuition fee will now have to pay more for this service.

If the elementary aggregates under the education division (or health and social protection categories) are stratified according to income levels and the price paid for the service, then it is relatively straightforward to apply the new lower price for that segment of the classification structure of the HICP. If, on the other hand, this technique is not an option, perhaps because of a lack of information, then another approach can be applied, which is very similar in practice to changes to a tariff structure and its effect on the price index. See Section 7.4 on tariffs for more details on how to treat a change in tariff structures.

Beyond the situations described above, many other types of arrangements and schemes exist in the healthcare, education and social protection fields that can often blur the price that should be recorded for the HICP.

For example, prices that vary according to household income (i.e. income-dependent prices) occur in many jurisdictions and often challenge the price statistician. These schemes, although similar in spirit, can be applied often quite differently from one jurisdiction to the next, which makes it difficult to offer a *one-size-fits-all* methodology for measuring the prices to be used in the HICP.

The following five examples provide some guidance on what to do in the kind of circumstances described above.

Example 1: Reimbursements (tax credits) vs direct subsidy

In this example two Member States offer childcare services, but each uses a different strategy to reduce the cost of childcare services for the household.

Country A pays a price subsidy to the service provider, country B uses the tax system and provides a tax credit to the household. How to treat both cases in the HICP?

In this example, Article 4(2)(a) of Regulation No 2166/1999 applies: *The purchaser prices of goods and services in the health, education and social protection sectors to be used in the HICP shall be the amounts to be paid by consumers net of reimbursements.*

In country A, the entity offering childcare services charged a price of €20 per hour at period t–1; at period t, the price of the services increases to €21 per hour.

Children typically spend 50 hours per month in the kindergarten so the generated revenue for the entity for the service goes from €1 000 per child to €1 050 between both periods.

To recognise the greater burden on the household caused by the higher price, the hourly price subsidy offered by the public authorities to the service provider is also increased from €8 at period t–1 to €9 at period t.

These subsidies translate into an unchanged *net* price paid by the household of €12 in both periods.

In the case of country B, the situation is exactly the same, except that the authorities offer an income tax transfer (tax credit) instead of a price subsidy. As a result of the increased price, the household now receives an increase in its childcare allowance from the previous amount of €400 at period t -1 to €450 at period t.

Regardless of the approach used for reducing the burden from the higher price of the service, the net cost to the household for consuming the childcare service is the same for both countries. This is also what needs to be reflected in the HICP. What matters is the net price. Both strategies to reduce the costs of childcare services for the household lead to the same result in the HICP. This treatment is fully in line with the treatment in national accounts.

Example 2: A rule change

This example (see Table 12.1.2) provides an illustration of a case where the purchaser price has changed as a result of a change in policy and its effect on the HICP. Regulation (EC) No 2166/1999, Article 4(2)(b) applies here: *Changes in purchaser prices which reflect changes in the rules determining them shall be shown as price changes in the HICP.*

A market price is initially charged by an institution and is set at €20.00 at period t-1; moreover, of that amount €1 is paid directly by the household (i.e. the purchaser price) while the public authority pays the balance of €19.00. At period t, the public authority dramatically reduces the price subsidy to €12.00. Conversely, the burden of the cost paid by households now increases from €1.00 to €8.00. The price index for this service at period t (period $t-1 = 100$) is now 800 (= €8.00/€1.00 x 100). The fact that this change in government policy affects this component of the HICP respects the spirit of the Regulation, as consumers now pay more at period t for the service compared with period $t-1$ because of the change in policy.

Table 12.1.2: The effect on the HICP of a lowering of the price subsidy on a product

	$t-1$	t
Price charged by institution for the service (in €)	20.00	20.00
— Share of price paid by public authority (in €)	19.00	12.00
— Share of price paid by household (in €)	1.00	8.00
HICP ($t-1 = 100$)	100.00	800.00

Example 3: Income-dependent prices — scenario 1

Income-dependent prices present another example of how a change of policy by the public authority can affect the index. An income-dependent price can for example be any tariff where the price paid by a consumer is a function of his or her level of income in a given period. The ways that an income-dependent price may manifest itself will be made clear with the upcoming examples. It is important to identify all products in the HICP sample whose price is related somehow to household income in order for them to be treated appropriately in the HICP. It should be noted that income-dependent prices only change when the level of income changes as a result of a wage increase or a policy change, or both.

The challenge is how to estimate a price index that will best mirror these price changes. In accordance with a fixed basket approach, the structure of consumption is held constant and is not adjusted for the period between planned weight updates, i.e. December of year $t-1$ and December of year t. This principle of fixity extends beyond the basket to include the socio-demographic characteristics and income structure of the target population. Of course, the reality is that these factors can vary at any point during the 13 months between the weight updating periods. However, for practical reasons such as data limitations (e.g. issues of data availability and prohibitive cost of collecting the data on an ongoing basis), they are assumed not to vary during this period.

Changes in household income leading to a change to the price paid for a good or service in the health, education, and social security sectors are covered in Article 4(2)(d) of Regulation No 2166/1999: *Changes in the purchaser prices resulting from changes in purchasers' incomes shall be shown as price changes in the HICP.* The following examples depict various possible scenarios where this Regulation applies.

Example 3 (see Table 12.1.3) illustrates a case with childcare services in which this category has been segmented into three elementary aggregates, one for each of the three pre-defined income segments: (1) less than and including €20 000/yr.; (2) over €20 000/yr. and including €20 500/yr.; and (3) above €20 500/yr. At period $t-1$, the eligibility threshold is at income level €20 000/yr.

Table 12.1.3: An example of the effect on the index when the income threshold is changed to match the change in income.

	Annual income threshold of €20 000			Annual income threshold of €20 500			
	Weekly rates (in €)	**Share of households within bracket**	**Average weighted price per week (in €)**	**Weekly rates (in €)**	**Share of households within bracket**	**Average weighted price per week (in €)**	**Price index (t/t−1)**
Household income (in €)	Period (t−1)			Period t			
Less than and including 20 000	100	0.30		100	0.20		
Over 20 000 and including 20 500	300	0.10		100	0.10		
Above 20 500	300	0.60		300	0.70		
			240			240	100

Let us assume that the household budget survey shows that 30 % of households in the population qualified for the subsidised childcare rate while the remainder of households did not so that they paid the full rate in period t−1. The average rate paid for the subsidised service was €100/week for that period compared with the average unsubsidised rate of €300/week. The average price for childcare services in period t−1 is, for the population, a weighted average of €240/week (= (€100 x 0.30) + (€300 x 0.10) +(€300 x 0.60)).

The equation to calculate the index is:

$$\text{Index} = \frac{\sum(S_j^t \times P_j^t)}{\sum(S_j^{t-1} \times P_j^{t-1})}$$

Where:

S_j^t : Share of households in income category j in period t

S_j^{t-1} : Share of households in income category j in period t−1

P_j^{t-1} : Price or rate that applies to income category j in period t−1

P_j^t : Price or rate that applies to income category j in period t

Note that the formula is not a Laspeyres-type index. It is simply the ratio of the weighted average of prices (or rates) from period t to the weighted average of prices (or rates) in period t−1. Moreover, the weight is expressed as the share of households in that specific income range for a given period. This 'share-weight' can change over the two periods unlike a Laspeyres-type index where this share would remain invariant (at least within the same basket period).

Subsequently, in period t, the authorities decide to adjust the eligibility threshold by increasing it to €20 500/yr. so that it matches the measured increase in average incomes between both periods. This way, after the change, the share of households in the population benefiting from the reduced rate remains the same as before (30 %). Furthermore, the average price paid for the service (i.e. €240/week = (€100 x 0.20) + (€100 x 0.10) +(€300 x 0.70)) is also unchanged and thus the price index over the two periods equals 100, which is the expected outcome when the threshold is adjusted at a rate equal to that of incomes (in this example income rose by 2.5 % annually and so did the threshold).

Example 4: Income-dependent prices — scenario 2

This example is based on the same information as example 3 but this time the authorities have not adjusted the income threshold over the two periods, so it remains at €20 000/yr. However, household incomes have risen at the same 2.5 % annual rate as in the previous example. A circumstance such as this will unavoidably lead to some households losing the benefit of the lower rate.

Therefore, each elementary aggregate will now consist of a new distribution of households according to income brackets (see Table 12.1.4) and a new distribution of eligible households. Note that in this case, with the new distributions of eligible households, that the index over periods t–1 and t, is 108.3 as a result of the increase in average price paid over the period from €240/week to €260/week (= (€100 x 0.20) + (€300 x 0.10) +(€300 x 0.70)).

Table 12.1.4: An example of the effect on the index when the income threshold is not changed to match the change in income.

	Annual income threshold of €20 000			Annual income threshold of €20 000			
	Weekly rates (in €)	Share of households within bracket	Average weighted price per week (in €)	Weekly rates (in €)	Share of households within bracket	Average weighted price per week (in €)	Price index (t/t-1)
Household income (in €)	Period (t–1)			Period t			
Less than and including 20 000	100	0.30		100	0.20		
Over 20 000 and including 20 500	300	0.10		300	0.10		
Above 20 500	300	0.60		300	0.70		
			240			260	108.3

Annex 12.1.2 presents a more complex but also real case study of changes that occurred in the German healthcare system. Under the regimes, the reimbursements for healthcare claims varied according to whether an individual was a member of the public social security system, a civil servant or had private insurance.

12.1.5.3 Quality change

Under Article 3 of Regulation No 2166/1999, when the quality of a good or service in the health, education and social protection fields changes, prices should be treated according to the rules applied for specification changes, and, in particular, those regarding quality adjustment pursuant to Article 5 of Regulation No 1749/96.

The reality in the health, education and social protection sectors is that many products do not undergo any perceivable period-to-period quality change. When they do, assessing the monetary value associated with the change is almost impossible (except in the obvious case of a change, for example, in package size for medicines). For example, an improvement in the student-to-teacher ratio or the hiring of more experienced and better trained teachers in a private school, new and improved paid-for medical testing procedures, or even renovations to the physical facilities of a nursing home are all examples of quality change in these fields for which a monetary value cannot be practically or reliably assigned. In most cases, the only realistic solution for the price statistician is to assume that no change has actually occurred and therefore estimate the index accordingly. Such a decision is not likely to have an adverse effect on the overall HICP, since the relevant basket weight in the index is, in most cases, quite small.

An exception is prescription medicines, as the EU has taken legislative initiatives to shorten the time span of patent coverage of branded drugs and each Member State may have their own distinct programmes to promote the use of generic substitutes to reduce the cost of providing public healthcare services.

When a drug patent expires then it is commonplace to have both a generic substitute and the branded drug on market at the same time. Typically, the generic drug will sell for a lower price than the branded drug. If there is no clear or proven difference in quality features between the original and generic drug, it may be appropriate to treat them as close (or even perfect) substitutes [126]. In practice this would mean that the proper target measure for drug categories where generic drugs emerge is to show the changes in market shares of different producers (branded and generic) as a price change in the index without any corresponding quality change. In practice this means comparing market-share weighted class mean prices with the corresponding package size adjustment, if applicable.

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[126] For simplicity it is assumed here that quality means that the outcome of each type of drug (branded or generic) is identical.

If, on the other hand, the generic drug is indeed different from its branded counterpart, it cannot be considered a close substitute. Under such circumstances, the best option is to track the prices of both the branded and generic varieties and possibly weight them by their relevant market shares. In this way, when a branded drug comes off patent and a new generic drug is then marketed, the price decrease of this branded drug resulting from the market dynamics that follow the introduction of the generic drug on the market will be properly captured in the index.

12.1.5.4 Zero to positive prices and tariffs

Regulation No 2166/1999 Article 4 states that where goods or services, in the health, education and social protection sectors, have been made available to consumers free of charge and subsequently an actual price is charged, the change from zero to an actual price, and *vice versa*, shall be reflected in the HICP. Note that this price development must occur between basket updates, since goods and services in the health, education and social protection sectors that are offered for *free* to households (i.e. are fully subsidised by the Member State) during the price reference period as well as during the current month are out of scope of the HICP, because the household's expenditure weight is nil.

Section 7.5 provides insights on how to account for a product that was initially available for free, but is subsequently provided on the market for a positive price (and *vice versa*). Section 7.6 also discusses the treatment of bundling where goods and/or services are sold together for a single price which may be different from the sum of the prices of the individual components. Together, these two situations form the basis of Article 5 of Regulation (EC) No 2166/1999.

An exceptional borderline case is presented in Annex 12.1.1, this shows how the Netherlands treated in their HICP a reform that led to a broadening of the population coverage of *free* government-sponsored healthcare. If the regulation had been implemented in line with the Regulation (EC) No 2166/1999, this would have led to a perverse outcome. As a result, Recommendation 2005/881/EC was introduced.

Article 4(6) of Regulation No 2166/1999 states that where relevant, the procedure provided for tariffs in Regulation No 2646/98 (regarding the treatment of tariffs) shall apply *mutatis mutandis* [with the necessary changes having been carried out].

As discussed in preceding sections, tariff pricing is common in the area of health, education and social protection. For the treatment of this type of pricing strategy and how to properly estimate the weights of tariffed products in the HICP, the approach for goods and services in this sector is the same as that presented in Section 7.4, which explains the methodology of tariff pricing in greater detail.

Annex 12.1.1: The case of healthcare reforms in the Netherlands

Context

Healthcare insurance in the Netherlands was reformed in January 2006. Prior to that period, both private and public healthcare co-existed in the country. With the new compulsory basic social insurance scheme that was introduced in 2006 it was expected that a much larger share of healthcare would cover the total population. Consequently, 37.5 % of the total population were expected to shift from the private to the new social insurance scheme.

The reform introduced a fundamental change in the organisation and institutional structure of the healthcare system which raised concerns about its appropriate treatment in the HICP given the existing legal framework. Under the new scheme, the entire population would have access to the free basic healthcare services; this service would be covered by the public healthcare system and be provided for free. Health services that provided above the basic level would be covered by a private healthcare insurance system which everyone needed to join.

From an HICP perspective, the reform meant that after 2006, a larger share of the population compared to the pre-2006 reform would now have access to *free* insurance and the corresponding free health services.

The price statisticians in the Netherlands (Central Bureau of Statistics) interpreted the Regulation (EC) No 2166/1999 in the following manner:

- Healthcare that is covered by social insurance is not part of the coverage of HICP. The medical goods and services are available free of charge, except for a possible nominal own contribution fee that consumers pay for some medical goods or services.

- Healthcare that is covered by private insurance or not covered by any health insurance at all is part of the coverage of HICP. The price of private health insurance and the full price of these medical goods and services are included in the HICP.

- Article 4(4) of Regulation No 2166/1999 explains that where goods or services in the health, education and social protection sectors have been available to consumers free of charge and subsequently a fee is charged, then the change from a zero price to a real price, (or *vice versa*), must be taken into account in the HICP.

- Therefore, the shift from private insurance to social insurance must be taken as a price falling to zero and the shift from social insurance to private insurance must be taken as a price going from zero to the market price.

Assuming that the Regulation would be implemented as prescribed, it was expected that the impact of the healthcare reform would lower the headline estimate of the HICP by anywhere between 3 to 4 percentage points compared with the level it would have been had the Regulation not been accounted for in the index. This led to some questions about the interpretation of the Regulation. The section below discusses the new Recommendations that flowed from this event.

Recommendations

Recommendation 2005/881/EC was developed in order to establish a clear distinction between developments considered to be price changes and those that are changes in population or consumption and thus do not affect the HICP.

This Recommendation makes a distinction between:

1. changes in the eligibility and access rules for social health insurance; and

2. changes in the prices in a single scheme and price changes resulting from changes in the rules determining prices in a single scheme.

The first type of change is *not* considered for the purpose of the HICP to be a price change. By contrast, changes of the second type are considered to be price changes and should be reflected in the HICP.

This Recommendation implied that the change in the health insurance scheme fell under the first type of change and therefore no price change should be recorded.

Meaning of the Recommendations

1. In cases where both private and public health insurance co-exist in a country, then a price index for healthcare insurance should be stratified in two parts: a stratum for private health insurance and a stratum for public health insurance. Prices changes would then be applied to their respective stratum.

2. This flows from the first Recommendation where each of the strata would have its proper weight according to the health insurance regime and healthcare service which applies. The corresponding price behaviour would be estimated according to the stratum to which it belongs.

3. The new weights to be introduced in January of each year should reflect the new insurance regime in that country. Until the weights are updated, the price index for health insurance should be based on prices drawn from the existing regime only and not reflect any changes in prices as a result of the new regime.

Annex 12.1.2: The effect of reimbursements relating to social protection on purchaser prices in the HICP — an example, Germany

Table 12.1.5 contains examples of the effect on purchaser prices of certain kinds of reimbursements and claims in the case of the German healthcare system. Note that the table includes three distinct groups of people (members of a social security system, civil servants and privately insured individuals).

They are divided according to the particular social protection regime under which they are covered. For example, the price that should be recorded for the HICP in cases when the person is a member of a publicly sponsored healthcare regime would be the price paid by that person for a healthcare good or service, minus the corresponding reimbursement due to that person.

Table 12.1.5: The case of Germany: Examples of various kinds of reimbursements in the healthcare system and their effect on the purchaser price as they relate to different groups of people (127)

Description effect on the purchaser price	
Members of a social security system	
Pay private co-payment (e.g. prescription fee, practice charge).	Private co-payment.
Pay total price and receive reimbursement.	Total price less the reimbursement.
Pay total price with no reimbursement (for goods and services that are not refundable).	Total price.
Pay total price and get no reimbursement (for goods and services that are not refundable) from social security but receive payment of claims from a private supplementary health insurance.	Total price (payment of claims from private insurance companies cannot be deducted).
Pay nothing as a person receiving income support or qualified as chronically ill.	Price is zero[127]
Pay total price (or private co-payment or total price less reimbursement) and receive a tax refund (e.g. it is considered an extraordinary burden).	Tax refund is an income transfer and cannot be deducted.
Civil servants	
Pay total price and receive a grant (e.g. a 50 % contribution towards the cost of healthcare) from employer.	Grant is treated as reimbursement and deducted from the total price.
Pay total price and receive a grant (e.g. a 50 % contribution towards the cost of healthcare) from employer and receive (e.g. 50 %) payment of claims from a private insurance company (also as a voluntary member of a public insurance company)	Grant is treated as reimbursement and deducted from the total price; payment of claims cannot be deducted.
Pay total price, after reduction for grants and payment of claims receive a tax refund (e.g. for extraordinary burden).	Tax refund is an income transfer and cannot be deducted.
Private health insured persons	
Pay total price and receive from private insurance company payment for the claim.	Total price.
Pay total price and receive from private insurance company the payment for the claim and also receive a tax refund.	Total price.

(127) Changes in definitions (e.g. a chronically ill person is a person who has to pay more than 2 % of annual net income for health goods and services) are reflected as a price change in the HICP.

12.2 Insurance services

12.2.1 Introduction

The basic economic activity of insurers involves the collection of premiums from and the payment of claims to holders of insurance policies. Two elements characterise the activity of insurance companies.

First, they pool the risks of the insured policyholders by using premiums received to pay claims to those who suffer loss or damages. Second, they maintain and manage financial reserves so that they can meet unknown future claims. Most of the revenues generated by insurance companies are from premiums, interest and other income from reserves. In brief, insurance activity organises a redistribution of money among insured households to replace or reimburse loss or damaged property covered by insurance policies.

In so doing, insurance companies provide a service to the policyholders. Expenditures of households, as policyholders, for insurances services are covered in the HICP. However, this only applies to non-life insurance, e.g. health, vehicle and home contents insurances, while life insurance and real-estate (buildings) insurance are excluded from the coverage of HICP (see Chapter 2).

The *basic principle* underlying the treatment of insurance services in the HICP is that weights, but not prices, are recorded net of claims.

The weight for insurance in the index should reflect the consumer expenditure for the fee included in the insurance premiums for providing insurance services to households. This fee is known as the *service charge* and largely corresponds to the premiums paid by households net of claims paid to them by insurers. Accounting for the expenditure for premiums net of claims in this way is referred to as the *net approach*.

This net approach thus recognises the service charge as the expenditure for consuming the insurance service. The other part of the premium, corresponding to reimbursement of claims, is an element of the redistribution among households and thus is not expenditure for a service from an insurer. By thus excluding the redistribution part from the insurance service expenditure, the net approach is consistent with the notion of the HICP as an indicator of consumer inflation and the concept of household final monetary consumption expenditure. The net approach also avoids double-counting expenditures made by households after insurance claim reimbursements for the ensuing repairs or replacement of property lost or damaged.

Although the weight for insurance is calculated based on the net weight approach, the same approach cannot be applied to the prices (i.e. premiums) used to compile insurance in the HICP, for practical reasons. Therefore the full or *gross prices* are used. Accordingly, it was agreed that a net weight, gross premium approach would be adopted for the treatment of insurance services in the HICP. The next section describes how this should be implemented.

12.2.2 Legal requirements and definitions

Article 2 of Commission Regulation (EC) No 1617/1999 of 23 July 1999 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 — as regards minimum standards for the treatment of insurance in the Harmonised Index of Consumer Prices and modifying Commission Regulation (EC) No 2214/96 [128] provides the following terms and definitions:

Article 2

Definitions

For the purpose of this Regulation the terms given below are defined as follows:

1. *'gross insurance premiums': the amount paid by the policyholder for a specific insurance policy to obtain insurance cover;*

[128] OJ L 192, 24.7.1999. p. 9.

2. *'claims': the amount which the insurance company pays to the policyholder and other parties in settlement of injuries or damage suffered by persons or goods;*

3. *'premium supplements': the income earned by insurance enterprises by investing their insurance technical provisions, which comprise prepayments for insurance premiums, provisions for outstanding claims, and provisions against outstanding risks;*

4. *'actuarial provisions': allocations by the insurance company to technical provisions against outstanding risks;*

5. *'service charge': gross insurance premiums plus premium supplements minus claims minus changes in the actuarial provisions.*

Article 3 of the same Regulation gives the rules for insurance weights and prices:

Article 3

Treatment of insurance weights

1. *The weights for insurance shall be an estimate of the aggregate expenditure by households on service charges for insurance covered by the HICP expressed as a proportion of the total expenditure on all goods and services covered. The weights shall reflect the average aggregate expenditure during three years.*

2. *Expenditure financed out of claims shall be treated as being incurred by the policyholder or other parties to the claim and not by the insurance company. The weights of the HICP sub-indices shall include such expenditure where it is incurred by or on behalf of the household sector.*

Article 4

Treatment of insurance prices

1. *1. The prices used in the HICP for the compilation of insurance-price indices shall be the gross insurance premiums.*

2. *The gross insurance premium shall be taken as the full premium that is payable for the policy and shall not be adjusted, even if the premium or the cover value of the policy is index-linked.*

3. *Subject to paragraph 2, for each insurance policy in the target sample the price-determining specifications shall be kept constant. Where those specifications change, prices shall be treated according to the rules applying to quality adjustment laid down in Article 5 of [Regulation] (EC) No 1749/96.*

Article 5

Comparability

HICPs constructed following the procedures described in Articles 3 and 4 of this Regulation or following other procedures which do not result in an index which differs systematically by more than one tenth of one percentage point on average over one year against the previous year from an index compiled following those procedures, shall be deemed comparable.

In accordance with Regulation (EC) No 1749/96 concerning the coverage of goods and services in the HICP, the following ECOICOP categories of insurance services are covered (with the relevant notes quoted below):

12.5.2 Insurance connected with the dwelling

Refers to all service charges paid by owner-occupiers and tenants for the kinds of insurance typically taken out by tenants against fire, theft, water damage, etc.; see also Annex Ib Nos 7, 8 and 24.

12.5.3 Insurance connected with health

Refers to service charges for private sickness and accident insurance; see also Annex Ib Nos 7, 8 and 24 and the methodological details of inclusion of category '06. Health' as specified in accordance with the procedure laid down in Article 14 of Council Regulation (EC) No 2494/95.

12.5.4 Insurance connected with transport

Refers to service charges in respect of personal transport equipment, travel insurance and luggage insurance; see also Annex Ib Nos 7, 8 and 24.

12.5.5 Other insurance

Refers to service charges for insurance such as civil liability for injury or damage to third parts or their property not arising from the operation of personal transport equipment; see also Annex Ib Nos 7, 8 and 24.

The relevant explanations of Annex Ib in the above Regulation, referred to in the notes quoted above, elaborate on some borderline cases, including social contributions (not covered) and premiums payable under policies taken out by institutional units (not covered). See Chapter 2 on coverage.

12.2.3 Classification of insurance services

Under Article 2(11) and Article 3(6) of Regulation (EU) 2016/792, HICP sub-indices should be compiled for the categories of ECOICOP, which classifies insurance services in the following way:

Insurance

Service charges for insurance are classified by type of insurance, namely:

[Life insurance and] non-life insurance (that is, insurance in connection with the dwelling, health, transport, etc).

Service charges for multi-risk insurance covering several risks should be classified on the basis of the cost of the principal risk if it is not possible to allocate the service charges to the various risks covered.

12.5.2.0 Insurance connected with the dwelling

> *Includes:*

> — service charges paid by owner-occupiers and by tenants for the kinds of insurance typically taken out by tenants against fire, theft, water damage, etc.

> *Excludes:*

> — service charges paid by owner-occupiers for the kinds of insurance typically taken out by landlords (intermediate consumption).

12.5.3 Insurance connected with health

> *Includes:*

> — service charges for private sickness and accident insurance.

> **12.5.3.1** Public insurance connected with health

> *Excluded from the HICP:*

> — social (compulsory) health insurance is classified as a social contribution and not as Household Final Monetary Consumption Expenditure.

> **12.5.3.2** Private insurance connected with health

> *Includes:*

> — health insurance paid to a private insurance company.

12.5.4 Insurance connected with transport

> **12.5.4.1** Motor vehicle insurance

> *Includes:*

> — service charges for insurance in respect of personal transport equipment.

> **12.5.4.2** Travel insurance

Includes:

— service charges for travel insurance and luggage insurance.

12.5.5 Other insurance

12.5.5.0 Other insurance

Excludes:

— civil liability or damage to third parties or their property arising from the operation of personal transport equipment (12.5.4).

Includes:

— service charges for other insurance such as civil liability for injury or damage to third parties or their property.

Regarding the ECOICOP definitions above, the following may be noted:

- Life insurance (ECOICOP 12.5.1, not mentioned above) – although the *service charges* for life insurance are included in both household final consumption expenditure and household final monetary consumption expenditure — is nevertheless excluded from the HICP under Regulation (EC) No 1687/98. This is for practical reasons, as the service charges for life insurance are often bundled with some form of saving or investment, so cannot be separately identified (see Chapter 2).

- Social (compulsory) health insurance (ECOICOP sub-class 12.5.3.1), mentioned above, is excluded from the HICP in accordance with point 22 of Annex 1b to Regulation No 1749/96.

- Private insurance connected with health (ECOICOP 12.5.3.2) includes accident insurance, private healthcare insurance and private income insurance.

- Motor vehicle insurance (ECOICOP 12.5.4.1) provides cover for fire, theft and damage to the motor vehicle. It also includes civil liability motor insurance for injury or damage to third parties or their property.

12.2.4 Insurance weights

In accordance with the net approach and Article 3 of Regulation (EC) No 1617/1999, the weights used in the index should reflect household expenditure on service charges for insurance covered by the HICP. Since this expenditure is not directly observable, being included in the premiums charged together with redistribution between households within the gross premium, it must be derived. According to Article 2(5) of the same Regulation, the weight of the service charge is derived as follows:

(+)	Gross insurance premiums
(+)	Premium supplements
(-)	Claims
(-)	Changes in actuarial provisions
=	Service charge

The above definition can potentially lead to negative weights, which are an artificial result of the estimation procedure and do not reflect the actual expenditure for the service to households. This could happen due to irregular and unexpected large fluctuations in claims due to natural disasters or large-scale incidents (e.g. major floods, hurricanes, oil spills).

Negative weights do not make sense in relation to household expenditure. To reduce the risk of obtaining negative weights, Article 3(1) of Regulation (EC) No 1617/1999 states that insurance weights should reflect the average aggregate expenditure over three years. This should provide for more stable weights with less risk of becoming negative. It is also consistent with the reasoning of insurance companies when managing the risk they face. When three-year average expenditures are used for insurance weights, the price updating of these weights should reflect

accordingly the average price development over the three-year period leading up to the price reference period, i.e. the most recent December (see Chapter 3).

However, it is important to note that negative weights can still occur as a result of the pricing strategies employed by insurance companies. This may happen if an elementary product group pertains to a certain insurance type, such as mandatory motor vehicle liability insurance. Insurance companies may choose to sell this insurance product at a loss for promotional reasons in order to attract customers to choose that company when purchasing other insurance products as well (e.g. comprehensive motor vehicle insurance). In such cases, elementary product groups should be redefined and expanded to include further types of insurance products, so as to avoid the problem of negative weights.

Article 3(2) of Regulation (EC) No 1617/1999 referred to above points out that payments for replacements, repairs and other expenditures financed out of claims are, according to the net approach, excluded from insurance weights; these expenditures are instead covered in their respective HICP sub-indices.

For example, after a car accident, either a new replacement vehicle is partially (or fully) financed, or the damaged vehicle is repaired out of the funds issued by the insurance company to the car owner from the claim. In the first case, the expenditure for the purchase of the new car funded from the insurance reimbursement is included in the weight for ECOICOP 07.1.1 — Motor cars; for the latter case, the expenditure is included in the weight for ECOICOP 07.2.3 — Maintenance and repairs. However, if the weights for insurance are derived from the national accounts, these requirements will automatically be fulfilled since they are compatible with that data source.

Taxes on insurance premiums are regarded as a part of the insurance service charge faced by consumers and form part of the net insurance expenditure weights.

Under the ESA 2010 (paragraph 16.38), negative weights due to volatility in claims are in principle no longer possible. Namely, output of non-life insurance uses adjusted claims incurred, which is an estimate corrected for volatility in claims. The HICP regulation text on this point refers to the system that existed at the time Regulation (EC) No 1617/1999 was agreed (ESA 1995).

It should be noted that the regulation rule of using three-year average expenditures for insurance weights remains in place, even though the volatility problem it was meant to solve in principle no longer exists, providing that national accounts data are used to calculate the weights.

Price updating of weights based on three years of expenditures

The weight calculation for the index of year t in a class of insurance products can be performed as follows. The procedure uses expenditure data for the three years $t–4$, $t–3$ and $t–2$, not just for year $t–2$ as in the case of other weights (see Chapter 3). Suppose that the service charge expenditures in € million for the class in years t-4, t-3 and $t–2$ respectively were 222.22, 225.55 and 229.99. The corresponding updating index (see below) annual averages (index reference year = 100) are 100.91, 102.11 and 104.12, and in December $t–1$ the updating index is 104.72.

Then the average over the three years of the service charge expenditure for the class in the prices of December $t–1$ is obtained as follows:

$$((222.22 / 100.91 + 225.55 / 102.11 + 229.99 / 104.12) \times 104.72) / 3 = €231.08 \text{ million.}$$

For example, €222.22 million in year t-4 is divided by the index number 100.91, to be deflated so as to be expressed in the prices of the index reference year. Then, the resulting amount is multiplied by the index number 104.72 so as to express the amount in the prices of December $t–1$.

To complete the weight calculation, suppose that the total expenditure on all other products in the household final monetary consumption expenditure during $t–1$ was €33 313.13 million. The weight per thousand for the class in question then turns out to be:

$$1\ 000 \times 231.08 / (33\ 313.13 + 231.08) = 6.88882.$$

The choice of the updating index

In the above weights calculation, a suitably chosen price index was used for price updating the weights of the service charge. The choice of the updating index is not specified in the Regulation. The insurance sub-index should

not be used for price updating the weights (i.e. the expenditure on the service charges), although doing so would be formally consistent with the fixed-basket principle. This is because price updating net expenditures (weights) with an index on gross prices would involve a conceptual discrepancy that could yield anomalous results, e.g. if gross premiums rise sharply to cover insurers' costs for a sudden rise in claims then the price-updated expenditures will increase as a result. The use of the all-items HICP can be taken as a suitable proxy for the price updating of the weights (expenditures), as changes in the service charges are more likely driven by factors that themselves are often influenced by the rate of change of the all-items HICP rather than by the price-determining characteristics of insurance policies (e.g. changing risk). The use of sub-indices of insured goods or services (e.g. electronic goods or hospital services) is not recommended as these reflect changes in one of the price-determining characteristics of an insurance policy that may not reflect the actual changes in the costs of the underlying service.

12.2.5 Insurance prices

12.2.5.1 Gross premiums

The prices to be used in the compilation of the insurance indices in the HICP are gross insurance premiums. This is clearly stated in Article 4 of Regulation (EC) No 1617/1999. This rule serves to ensure international comparability and continuity over time.

The choice of the gross approach rather than the net approach as the price target for the HICP was made for compelling practical reasons. Although it could theoretically be possible to use the net approach when considering a sample of policies over the long run, it would not be feasible to apply this approach over short periods and to individual insurance policies. Namely, in insurance company accounts, the data required to calculate service charges cannot be isolated and observed for short periods, owing to accounting routines, respondent burden and confidentiality.

Insurance companies set their premiums on the basis of long-term considerations, while in the HICP it is short-term price changes that are of concern. When setting premiums, insurance companies distribute exposure to risks across a wide range of policies and estimate expected future totals of claims. This means that it is impossible to derive individual net prices on a monthly and timely basis, and thus only gross premiums can, for practical purposes, be tracked for the HICP.

Nevertheless, the ideal target would be to follow the development of the service charges under constant price-determining conditions (i.e. constant quality). To that end, for a sample of insurance policies, gross premiums are followed as a proxy for individual service charges.

The prescribed approach implicitly assumes that the ratio of the service charge to the gross premium is constant in the short term. It seems likely that this assumption does not considerably affect the outcome of the index calculation, particularly as net weights are used.

Tax change

Tax levies on insurance premiums should be treated as a part of the insurance service charge. Changes in the gross insurance premiums should thus include any tax change that is applied to the insurance premium.

Following identical product offers

Once a sample of insurance policies, i.e. product offers, has been defined, it is important to ensure that in principle identical policies are being priced in the price reference period and subsequent comparison periods. This is in line with the general philosophy of constant quality underlying the compilation of the index, i.e. the product offers to be followed are those in which the characteristics of the insurance policy — characteristics of the insured person or property, the amount of insurance cover, excess fees and the scope of insurance coverage, etc. are held constant.

12.2.5.2 Sampling of insurance policies

The exact definition and the number of the sampled insurance policies required to construct indices depend, to a great extent, on the institutional and legal framework in a country. General points to be applied when selecting a sample of insurance policies are the following:

- *Representativity:* A sufficient number of representative policies should be selected in order to ensure that the majority of insurance products available on the market are covered.

- *Clarity:* For each policy selected for the target sample, the price-determining characteristics should be clearly identified, such as the demographics of the policyholder and the specific areas of risk which are insured.

In relation to the first point, care must be taken to ensure that a good sampling frame is used and that the selected sample is representative of the insurance market it is meant to cover. Where possible, different sources of information, such as associations of insurers and insurance companies, should be contacted and consulted to help Member States develop reliable sampling frames.

The sample of insurance policies should thus be selected so as to represent the insurance policies actually existing and in force at the time of sampling. The sample should be reviewed and updated as required every December, as consumers can switch providers at the time their contract is due for renewal in order to obtain the best deal. Binding contracts purchased earlier but still in force should be represented as well as newly purchased contracts, in principle in proportion to their market share. Preferably sampled insurance companies could be asked to help prepare frames for sampling insurance policies.

A clear identification of each policy's price-determining characteristics is important for the completion of the sample-building work and for collecting prices. Where applicable, the description of the insurance policy should include details such as the kinds of property or objects insured, the amounts or values insured, the amount of the excess, and price-determining features of the policyholder. This method is similar to the consumer profile approach to sampling representative product offers. Some examples of insurance policies that could be included in the ECOICOP 12.5 sub-index are:

- 12.5.2: Insurance providing cover for fire, theft and damage of the contents of a home (permanent address) for a person with no criminal record. Doors are reinforced and equipped with security locks. Total value insured is €25 000.

- 12.5.3: Insurance providing coverage for expenditures relating to a series of specified private medical treatments up to an annual total amount of €2 500 for a 25- to 35-year-old male. One third of the expenditure of medical treatments is not refundable until an amount of €200 is reached.

- 12.5.4: Insurance covering expenditures due to accidental damage of a particular make of car (petrol engine), provided that the car does not exceed 20 000 km a year, is owned by a 45-year-old driver who has had a driving licence for 15 years with no record of accidents within the past two years.

- 12.5.5: Civil liability insurance for third-party damage for a 30- to 40-year-old person, with an indemnity limit of €10 000.

12.2.5.3 Quality adjustment of insurance prices

Article 4(3) of Regulation (EC) No 1617/1999 explicitly addresses the issue of quality adjustment for insurance. Central to the measurement of inflation is the constancy of price-determining characteristics of the sampled insurance policies (i.e. product offers) over time. Examples of price-determining characteristics of insurance policies are various conditions and clauses stated in the policies, such as the amount or value insured, the maximum payable claim, and the excess amount (see below).

When characteristics of an insurance policy specified in the price reference period change, this could imply that the functionality of the specified insurance policy to policyholders has also changed. If so, the gross insurance premium should be quality-adjusted according to the same rules and principles that apply to other goods and services (see Chapter 6). Changes in the price-determining characteristics should thus not be reflected in the HICP as price changes but should be removed by the quality-adjustment process.

Quality adjustment may seem unusual in a situation like this, i.e. with product characteristics changing for existing product offers. However, over longer periods of time the amount insured by an insurance policy often increases to reflect the general change in prices of the consumer goods and services covered by a specified policy.

In the absence of a clear replacement at the time such changes occur, changes in the price-determining specifications must be treated according to the rules applying to quality adjustment.

Example: a change in the excess

An example of quality change is when there is a change in the excess stated in the conditions of the insurance policy. That is, claims paid out to policyholders for damages or losses are reduced by an amount (or a proportion) known as an *excess* or *deductible*. If the stated excess amount in the policy changes over time, this entails a change in the functionality of the insurance service to the policyholder and that is a quality change.

To make the example more specific, suppose that an insurance policy protecting against theft contains the condition that claims are paid only if the stolen good is worth an amount at least equal to the excess amount of €300, which is then deducted from the value of the stolen goods in the reimbursement. Now suppose that from 1 January of a given year, the excess amount is raised to €500. This change diminishes the degree of insurance protection and thus reduces the functionality of the insurance to the policyholder, who would therefore have reason to expect to pay a lower premium, everything else being equal.

From an index compilation point of view, the excess is one of the price-determining characteristics and needs to be monitored by the price statistician over time for any changes. If the excess changes for an insurance policy, the premium should be treated by the rules on quality adjustment in the HICP. An estimate has to be made of how large a change in the premium corresponds to the difference in expected compensations for damages, with regard to the risks. Approximations are most likely needed, as full data may be unavailable due to business confidentiality, which is vital to protect insurance companies from undue exposure to their competitors.

Example: a change in the amount insured (cover value)

In principle changes to the amount insured by (i.e. the cover value of) an insurance policy, between basket updates in December of each year, should be subject to quality adjustment. This is done by a measurement or an estimation of what difference in gross premium corresponds to the change in the amount insured. If this difference in gross premium is very small, then direct comparison of prices, without quality adjustment, can be used.

If the amount insured is index-linked, such an adjustment would be irrelevant and should not be made. If, however, the nominal amount insured by a policy is not index-linked, it should be updated by an appropriate price index; for example, that country's HICP or one of its components. The updating can be carried out by the Member State in the price collection, to correspond to the situation if the policy had been index-linked, and the amount insured thus automatically updated by the insurer. In principle, updates of the amount insured should be carried out at least once a year, in conjunction with annual resampling.

For example, consider an accident insurance with compensation amounts stated in monetary terms in the contract. The amount is €100 000 in the event of permanent total disability caused by an accident, while less severe injuries are compensated with stated percentages of the insured amount. If the policy is not index-linked, the amount insured can be updated with a suitably chosen price index, such as the all-items HICP or a sub-index within healthcare (i.e. within ECOICOP 06). If the price index increased by 2.0 % between times t and $t+1$, the updating works as in Table 12.2.1.

Table 12.2.1: An example: a change in the amount insured

	t		$t+1$		
	Amount insured	**Gross premium**	**Amount insured**	**Gross premium**	**Price change**
Adjusted (index-linked or correspondingly updated)	€100 000	€20.00	€102 000	€20.30	+1.5 %
Not adjusted	€100 000	€20.00	€100 000	€20.00	0.0 %

The column on the far right-hand side gives the impact on the price index for the accident insurance policy.

The impact on the gross premium of updating the amount insured has to be based on an enquiry to the insurance company.

Quality adjustment for changes in the amount insured can be relevant for types of insurance such as this, where the compensation for damage is immediately related to the amount insured, as a stated proportion of the latter. This approach is not particularly relevant for insurances such as home contents insurance, where the amount insured is an upper ceiling for compensation, which is based primarily on appraisals of the actual damage or loss, which are generally lower than the total amount of property insured.

Changes in risk are not treated as quality changes

Gross premiums should not be adjusted for changes in the risk of paying out a claim. Risk is not related to the quality of the insurance service from a consumer perspective but is one of many factors affecting the economy of the insurance business, together with interest rates on funds, other returns on investments, etc. In addition, it would not be practically feasible to adjust for risk.

It could be argued that a change in risk would entail a change in the functionality of the insurance to the policyholder. But a change in risk, e.g. due to a change in crime rate, is an environmental factor, so the resultant changes in the cost of insurance premiums should be reflected in the price index, and not adjusted for.

However, the range of risks covered by an insurance policy can be seen as an aspect of quality. For example, a travel insurance policy that covers extreme sports such as skiing and rock climbing could be considered as being of a higher quality than that of a policy which does not cover such activities. Such characteristics should not be adjusted for unless a replacement product offer includes such additional cover.

Table 12.2.2 below summarises the arguments put forward in relation to the quality adjustment of insurance prices (i.e. premiums) in the HICP.

Table 12.2.2: Changes in insurance policy price-determining characteristics (examples)

Changing variable	Quality adjust gross insurance premiums?	Justification
Automatic change of the amount (value) insured (index-linked)	No	The amount insured should reflect the depreciation of money and represent the value of the insured goods and services at base month prices (December of each year).
Extraordinary change of the amount insured	Yes	The amount insured changes by a discretionary rule (minimum threshold) established by law and not related to the risk of paying out a claim.
Price-determining demographic characteristics	Yes	Insurance indices should follow a particular insurance policy with its price-determining characteristics fixed over time.
Excess amount or other terms or conditions in policy contents	Yes	It is a price-determining characteristic.
Risk of paying out a claim	No	Not a price or quality feature of the insurance service, adjustment not practical. HICP convention.
Insurance premium tax	No	Insurance premium taxes are a part of the insurance service charge.

12.2.5.4 Bundled insurance products

Many insurance policies cover several types of risk. Bundling is often used by insurance companies in the form of multi-risk insurance products. For example, an insurance policy for home contents may insure for fire, theft, etc. but also for other risks, such as the loss of luggage when travelling or civil liability, all for a single price. This is a pure bundle. In such cases it is fairly straightforward to classify the insurance on the basis of the main risk, following the guidance given in ECOICOP (see section 12.2.3 above). Corresponding principles apply in cases where the price is itemised by components and therefore constitutes a mixed bundle. See Section 7.6 on the treatment of bundles.

12.2.6 Data sources for weights

The main data sources that may be used to derive household final monetary consumption expenditure insurance service weights can be broadly classified as:

- *supply side* data sources — insurance supervision authorities, business surveys, insurance companies.

- *demand side* data sources — national accounts, household budget surveys.

National accounts should normally be the primary source for weights of insurance services. The national accounts follow the net approach for insurance services and can thus directly provide data on the service charges, as required for the HICP. The data from this source is based on data collected from the insurance industry, duly edited and can thus be considered to be the most accurate that is practically available.

Data from other sources can be useful for breaking down weights to elementary aggregates or lower levels, including within ECOICOP categories. Depending on each country's data availability, these sources should be compared for best accuracy. Each of these different data sources may provide information that could complement other sources of information. Insurance supervision authorities, for example, could provide data on technically detailed accounts for the insurance industry.

Data from *business surveys,* although less detailed, could be used to complement the data supplied by insurance supervision authorities.

Household budget surveys, combined with the data provided by insurance supervision authorities on average share of service charge in gross premiums, can offer an alternative way of estimating insurance weights at low levels, although with somewhat coarse assumptions and approximations.

Specific data from *insurance companies* could be used similarly in coarsely approximate calculations of low-level weights. The details of the procedure would have to be worked out with regard to the structure of the available data. However, the availability of this data source could be restricted due to business confidentiality.

12.3 Purchase of motor vehicles

12.3.1 Introduction

Motor cars are in some ways distinct among consumer products. Firstly, cars are expensive, so that although not frequently purchased by most consumers, they have a relatively high expenditure share (weight) in the HICPs of countries. Secondly, cars are complex, being composed of many very different kinds of components, ranging from plain springs and seats to high-technological electronic devices controlling the engine, all of them contributing to the user functionality of the car.

Motor cars referred to here are of those types notably purchased by consumers, i.e. households. This primarily means passenger cars, but depending on the vehicle market in the country, other types could also occur, such as vehicles that are more or less like vans or small pick-up trucks.

The high weight of cars in the HICP, both new and second-hand, naturally entails that an adequate treatment of cars is crucial to the accuracy of the overall HICP. Furthermore, the high weight of second-hand cars makes it necessary that these purchases are reflected in the HICP, to the extent that they are purchases made by consumers from car dealers and thus within scope of the HICP (see Chapter 2).

This section on the purchase of motor cars partly draws on work undertaken in the CENEX project mentioned in Section 6.1.

12.3.2 Legal requirements for the HICP

Minimum standards on coverage of motor vehicles

In accordance with Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices (Annex 1a), the following ECOICOP categories of motor cars are covered:

07.1.1 Motor cars

07.1.1.1   New motor cars

07.1.1.2   Second-hand motor cars

Annex II to Regulation (EC) No 1749/1999 states that:

Purchases cover purchases by households of new vehicles and purchases, by households of second-hand vehicles from other institutional sectors, which are typically garages or car dealers. Sales of second-hand vehicles between households are not covered.

Purchases are net of sales by households of second-hand vehicles to other institutional sectors. Member States may take either:

(i)   a net weight for new cars (gross weight minus trade-in value of used cars), and a net weight for second-hand cars, or

(ii) a gross weight for new cars (not taking into account the trade-in [value] *of used cars), and a weight for second-hand cars including any business sector trade-margin.*

Purchases also cover purchases through financial leasing arrangements.

Note: The trade-in value refers to the price offered by the seller to the household for the used car when purchasing a car, be it new or second-hand.

The above Regulation text offers two options on how to distribute the weight of new and second-hand cars within the total. Section 3.4.2 provides examples of how these two options can be estimated.

12.3.3 Definitions and concepts

The definitions of concepts and methods for quality adjustment are described in Chapter 6.

The following definitions also apply:

Primary model: means a car model specification that allows for similar versions of the same brand, e.g. Volkswagen Golf.

Sub-model: means a particular version of a primary model, specified with respect to engine version and distinguishing features or equipment details, e.g. Volkswagen Golf V 1.9 TDI Trendline.

Minor change: means a quality change that involves changes in equipment details or detailed features of the car.

*Fundamental change***:** means a quality change that involves complex technological changes or modifications between models that normally result in differences of several (i.e. more than one) characteristics of the car, or changes in the basic functionality of the car, e.g. a considerable change in the internal space.

12.3.4 Recommendations

This section looks at the Recommendations. For clarity, the treatment of new and second-hand cars are presented separately. Although the Recommendations have not been formally adopted yet [129], they describe elements of good practice that can be used to comply with the legal requirements.

Recommendation 1: Stratification

The universe of car purchases, new and second-hand, should first be stratified according to the purpose of the car. Car size is the most commonly used proxy variable for the purpose of the car. The different car size groups can be taken as consumption segments if required [see Chapter 4]. These segments could be stratified further according to the type of engine (petrol, diesel, etc.).

For second-hand cars it is recommended to stratify according to age class.

Recommendation 2: Target sample

Primary models should be selected, preferably within strata, by probability sampling or a combination of probability and cut-off sampling. Unless justified, it is not recommended to apply only cut-off sampling.

Sub-models should be selected by purposive sampling according to well-defined criteria like representativity (large sales), unless probability sampling is also used for sub-models.

Recommendation 3: Price collection

Transaction prices are the preferred prices to collect and use. As an approximation of transaction prices, list prices for the chosen sub-models may be used. All unavoidable costs linked to the purchase of a car such as taxes, duties and delivery charges (if applicable) are to be included.

Recommendation 4: Product replacement

When a sub-model is replaced, the replacement model should be within the same primary model. If a primary model is replaced, the replacement model should be within the same consumption segment. Generally, the main criterion for the selection of replacement models should be representativity.

Recommendation 5: Quality adjustment methods

Changes in the equipment of a basically unchanged model constitute minor changes. For minor changes, option pricing or supported judgements by product experts are the preferred methods for quality adjustment.

For complex technological changes or changes in basic functionality of the car, or the introduction of a completely new replacement model, bridged overlap is applicable.

For second-hand cars, supported expert judgement based on age and mileage can be used, or, alternatively, supported judgement can be combined with direct comparison or bridged overlap. Hedonic methods are also an option.

Recommendation 6: Annual resampling

Resampling is to be conducted in the December of each year and will take effect in January of the following year. Both the selection of primary models and of sub-models should be reviewed.

Recommendation 7: Leasing

Financial leasing of cars (purchase of cars via hire purchase agreements) by consumers should be included in the HICP and classified under ECOICOP 07.1.1. Operating leasing of cars by consumers resembles car rental and should be classified under ECOICOP 07.2.4.

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[129] At the time of drafting, official recommendations on the treatment of cars had not been agreed.

12.3.5 Explanatory text, new cars

12.3.5.1 Stratification (Recommendation 1)

If sub-groups of car models differ in purchase expenditure, precision can be improved by stratified sampling. Further, stratification with appropriate stratum weights helps ensure representativity where non-probability sampling is used, as is usually the case with car sub-models (see also Chapter 4)

In general, stratification by consumption purpose seems most appropriate (see below) in the case of new cars. This makes use of the identification of consumption segments. Whether stratification by type of outlet or by region is justified has to be checked at a national level. Engine power or size of the car may determine the tax regime for a car and hence be relevant stratification variables in some countries.

Identification of consumption segments

Consumption segments are described in Chapter 4. To identify consumption segments in the motor vehicle sector, for practical reasons, proxy variables can be useful. For new cars the size of the car is a suitable proxy variable. Small cars are predominantly used for short distance rides in urban areas, e.g. for shopping, while large cars are also suitable for long distances such as vacation trips.

It is suggested to segment the universe of new cars into different consumption segments according to different purposes. These segments, and the number of them, may differ between countries, depending on consumption patterns.

A baseline suggestion is to use the following segmentation based on a previous classification scheme of the European New Car Assessment Programme (Euro NCAP) [130]:

- Super mini
- Family car
- Executive
- Multi-purpose vehicle and family van
- Roadster sports
- Off-road 4x4 and pick-up

Either fewer or more strata, e.g. by type of engine (petrol/diesel/electric/hybrid) could also be considered.

Assigning the universe of car models to consumption segments can be achieved on the basis of both primary models and sub-models. Primary models, e.g. VW Golf V, often have several sub-models, which are specific engine and equipment versions of the primary model, e.g. VW Golf V 1.9 TDI Trendline.

Consumption segments may or may not be strata with explicit weights. Accordingly, weighting is described in strata rather than consumption segments. Consumption segments are useful in replacement situations (see Chapter 6).

Weighting of strata

It is suggested to explicitly weight strata according to the expenditure share. The expenditure can be obtained by multiplying the total number of sales from the preceding year by an average price for each stratum.

The total number of sold cars can be derived from the information in the central car register. This contains the number of initial registrations (from the preceding year) per primary model which can serve as a proxy for the sales frequencies of the primary models. An approximate average price for the stratum can be calculated from the collected/published list prices. If needed, a coarse adjustment can be applied to reflect that some car models are used more for business than others.

[130] http://www.euroncap.com/home.aspx

Use of the national car register

Information on which primary models are currently sold in a country can be obtained from the national car register. If this register also has information on the sub-models sold, the assignment of sub-models to consumption segments can be undertaken directly.

The national car register is usually an excellent source of data for this use, but some care has to be taken in using it. The degree of detail in the register often varies between brands. For some brands in some countries, the primary models may either be only partially subdivided into sub-models or not subdivided at all, while other brands may have many sub-models without any significant differences between them.

The exclusion of business cars

Business cars should not be covered in HICP as they are not part of household consumption.

The practical feasibility of this rule depends on whether business cars can be identified, for example through the national car registry.

The term 'business cars' refers to two cases:

1. Company cars provided by employers and used by employees in performing their duties.

2. Cars provided by self-employed persons to themselves and used in performing their business.

Employees often finance in part the price of the company car, to allow for private use of the car, and cars of self-employed persons are often used for non-business purposes too.

If the distinction between business and household car purchases can be made e.g. in the national car registry, business cars should be excluded. If no such distinction can be made, alternatives should preferably be investigated, such as data on leasing, or some type of expert judgement (e.g. conversations with car dealers), to adjust data from the registry. Approximate considerations should be appropriate, as the issue primarily concerns the weighting of strata rather than prices.

12.3.5.2 Target sample (Recommendation 2)

In accordance with the Recommendation, the sample should be constructed in a two-step process:

1. Select primary models by probability sampling or a combination of probability and cut-off sampling.

2. Select sub-models by purposive sampling.

Selection of primary models by probability or cut-off sampling

Two possible sampling methods are commonly used: probability sampling with probability proportional to size (PPS), and cut-off sampling (see Chapter 4).

PPS sampling is generally feasible given that access to national car registers with information on the number of registrations is commonplace. Another possibility is cut-off sampling within the strata. The selection criterion for both sampling methods is the number of initial registrations in the preceding year for each primary model. Normally probability sampling is preferred to cut-off sampling because all available primary models have a non-zero probability of being included in the sample.

Selection of sub-models

After the sampling of primary models, sub-models of the selected primary models have to be chosen. For this stage, purposive sampling is suggested.

The sub-models can be selected according to the following criteria:

- The sub-model should be representative (well sold).

- The sub-model should be expected to be on the market for some time.

If the national car registry contains information on sub-models, probability sampling can in principle also be used for selecting sub-models. This has to be done with some care, as the degree of detail in the register can differ between brands, so that sub-models may possibly not be easily identifiable for all brands. In some cases it may be necessary to carry out the final selection of sub-model with each car dealer.

Sampling of outlets

The sampling process also involves sampling outlets for price collection. This can be undertaken in the general sampling of outlets for most product categories, but for car outlets it can be efficient to start from the target sample of primary models. Using information from the manufacturers and importers it can be feasible to construct a sampling frame for outlets for the brands in question.

When the outlets have been sampled they can, if needed, help select representative submodels. So it can be appropriate to select outlets before selecting sub-models. The assistance of staff in sampled outlets to select sub-models can be particularly helpful for brands where the central car registry contains little data on sub-models.

12.3.5.3 Price collection (Recommendation 3)

A further complication which applies equally to new and second-hand cars is that individually negotiated discounts are often substantial in the car retail business. Consequently, actual transaction prices (purchaser prices) can deviate from practically observable price lists and price tags. Additionally, in a typical car purchase, the buyer's old car is often traded in as a part of the deal, where some portion of the discount on the new car can be hidden in the form of an overly high price for the car traded in. But out of necessity, list prices or asking prices have to be collected as a proxy, on the assumption that transaction prices are likely to move in parallel to list prices. This assumption has to be accepted as a convention, largely without explicit validation. If it is the case that the assumption is not fully true, because individual discounts do vary over time in relative terms, then this would contribute to hard-to-avoid conceptual uncertainty in the index.

List prices can occur in different forms, such as:

- a retail price recommended by the manufacturer or importer

- an offer price (asking price) of a car dealer.

In the first case, central price collection on the websites of the manufacturers is possible, while regional and outlet dimensions are disregarded. If car dealers are known to set offer prices that do not follow recommended retail prices of the manufacturers, the prices should be collected from the individual car dealers. The latter approach also has to be used if car models cannot be identified and tracked through time based on central sources such as websites.

12.3.5.4 Product replacement (Recommendation 4)

Assuming the primary model is still representative, replacements should preferably be undertaken by selecting a new sub-model of the primary model.

If a sub-model becomes rare on the market or disappears, it should be replaced. If the primary model itself needs to be replaced, the replacement model should normally be of the same brand and should anyway belong to the same consumption segment as the replaced model. For a newly chosen primary model, a new sub-model also has to be selected.

12.3.5.5 Quality adjustment (Recommendation 5)

The complexity of cars entails challenges for quality adjustment, where simplifying assumptions have to be accepted by convention. Changes in readily observable features have to be taken as indications of changes in user functionality of more subtle kinds, such as driving pleasure or safety. The high weight of cars makes it important for the accuracy of the overall HICP that the quality adjustment works properly, although the quality development for cars has not been as overtly spectacular as for some electronic products.

Quality adjustment takes on somewhat different roles for new versus second-hand cars. For new cars, quality changes are often due to innovations, such as technological improvements and newly introduced measures for environmental protection, etc. For second-hand cars, these innovations are smoothed in over time, so quality changes in second-hand cars in general represent shifts in the structure of purchase transactions, with respect to age and mileage of the purchased cars.

Quality changes in replacement situations are classified as either minor or fundamental changes, as defined in section 12.3.3 above.

In practice, borderline cases occur, both between quality change and no quality change, and between minor and fundamental change. In such cases judgements have to be applied as consistently as possible. Generally, changes in superficial features, such as colour or wheel design, should not be seen as quality changes and thus should not be quality-adjusted for. Chapter 6 discusses in detail the main quality adjustment methods used in the HICP.

Quality adjustment in the case of minor changes — option pricing

Option pricing is a preferred method for quality adjustment in respect of minor changes and is considered an A method. An alternative is supported judgement by product experts, but this method is to some extent subjective and is therefore considered less preferable and is thus a B method.

Option pricing can also be used for changes in the fuel economy or engine power of a car.

Minor quality changes are, for example, changes in the contents of the standard equipment package, such as the inclusion of a GPS system or a parking sensor.

Option pricing is applicable if the newly added standard equipment was available as an option prior to the inclusion into the standard equipment package. However, it is also applicable in other cases where option prices can be collected for optional extras to a similar car model without the features in question.

The price of the new model is adjusted for 50 % of the price that the added equipment would have when purchased as an option for a model without it. The motivation for this 50 % reduction is explained in Chapter 6.

Example 1: New features and option pricing

In period 1 (the price reference period), a model had a list price of €21 000. The model is replaced in period 2 by a similar model that differs in two respects. Namely, navigation system and parking assistant where optional in period 1 but are included as standard equipment in period 2. The price in period 2 is €22 400. In period 1 the prices for the two optional features were €350 and €500.

The quality-adjusted base price for period 1 is calculated as:

$$€21\,000 + 0.5 \times (350 + 500) = €21\,425.$$

Thus, after the quality adjustment, the resultant price relative is:

$$22\,400 / 21\,425 = 1.0455075$$

In this example, the quality adjustment is applied to the price reference prices. Accordingly the option prices used are also taken from the price reference period.

There are two further cases where forms of option pricing are applicable:

- a change in the fuel consumption of a car
- a change in the engine power of a car.

If the *fuel consumption* of a car changes, this can be adjusted by calculating an option price for a hypothetical amount of mileage.

Example 2: Changes in fuel consumption and option pricing

Based on the two following assumptions:

1. A mileage of 15 000 kilometres (km) per year, i.e. 75 000 km in five years.

2. The consumer is assumed to evaluate the value of changed fuel consumption for the next five years on the basis of the current price of petrol, e.g. €1.14 per litre.

In period 1 (the price reference period) a model had a list price of €32 000. The model is replaced in period 2 by a model that is basically the same but differs in one respect that matters to users, namely that the stated fuel consumption is changed from 7.0 to 6.4 litres per 100 km. The price in period 2 is €34 200.

The value of the change in fuel consumption is calculated by multiplying the difference in fuel consumption over 75 000 kilometres by the current fuel price.

Thus the value of the improved fuel economy is: (7.0-6.4) / 100 × 75 000 × 1.14 = €513.

Applying this calculated option price for 100 % means that the quality-adjusted reference price is €32 000 + 513 = €32 513.

Then the resultant price relative is 34 200 / 32 513 =1.05188694.

In the above example on fuel economy, some conventions were applied:

1. An assumption of a five-year time period of *use* that the purchaser plans for at the time of purchase.

2. An assumption on annual mileage.

3. An assumption on future fuel price.

4. An assumption that the value to the consumer of the difference in characteristics is 100 % (not 50 % as in the preceding example) of the option price.

The choices of the figures in points 1-3 may seem arbitrary but have a minor impact on the index.

There is a particular motivation for point 4, as fuel economy is a special case, as everyone likes to save money and all car buyers intending to use the car benefit fully from expected savings in fuel expenditures, it is justifiable that the value is taken as 100 % of the option price. For most other features, such as a navigation system or a parking assistant as in example 1 above, a reduction to 50 % of the option price is sensible, as many potential buyers may not find the feature valuable enough to pay for.

If the *engine power* of a car changes this should be adjusted by applying supported expert judgement calculating an option price. This calculated option price should be based on (estimated from) the price range of sub-models that only differ with regard to engine power.

Example 3: Changes in engine power and option pricing

Suppose that two sub-models in period 1 (the price reference period) period have engine power of 81 kW and 92 kW, and list prices of €22 000 and 23 500, respectively. In period 2, the cheaper model is replaced by a similar model that differs in one respect that matters to users, namely that the engine power is changed to 85 kW, and the price is now €22 750.

A calculated base period option price per kW is then obtained as a ratio between the differences in price and in engine power of the two sub-models, in the base period, that is:

(23 500 − 22 000) / (92 − 81) = 136.36363

The quality-adjusted base price of the cheaper model is thus:

$$22\ 000 + 136.36363 \times (85 - 81) = 22\ 545.45452$$

and the resultant price ratio f or this model is:

$$22\ 750 / 22\ 545.45452 = 1.0090726$$

As with in the example on fuel economy, the value to the user is taken as 100 % and not 50 % of the option price, as the change is assumed to be of value to all purchasers. Here the choice may not be quite as obvious, but it can be argued that engine power like fuel economy is valuable to all users.

Generally, the prices for options should preferably come from the manufacturer or a retailer of the model or equipment in question. If such a price is not available, prices pertaining to a similar model could be used.

Fundamental changes and bridged overlap

In the case of fundamental changes, quality adjustment by option pricing or other explicit methods is not feasible as the replaced model and the replacement model are too far from being comparable.

Thus for fundamental changes, bridged overlap is the recommended method. The method assumes that the price development of other models of the same consumption segment would be similar to the replaced model. See Chapter 6 for a fuller description.

The above quality adjustment methods are suitable under different conditions. Table 12.3.1 below summarises the main methods available and their applicability.

Table 12.3.1: Main quality adjustment methods for cars

	Conditions		Preferred quality adjustment method
New cars Fundamental change		Minor change	Use option pricing
			Use bridged overlap
Second-hand cars	Where transaction data and hedonic methods are available		Use hedonic re-pricing comprehensively for all transactions
	Otherwise	Minor change	Use hedonic re-pricing of replacement models, or supported judgement
		Fundamental change	Use bridged overlap

12.3.5.6 Annual resampling (Recommendation 6)

Periodic resampling should be conducted every year. The timing of this periodic resampling depends on the publication date of the statistics on initial registrations (e.g. from the preceding year) by the central car register. Regardless of the date, the sample of cars should be updated in December of each year to ensure that the target sample included as of next January is as up-to-date as possible.

The selection process should be repeated as described for the construction of the target sample (see Recommendation 2). Depending on the sales figures (or the number of initial registrations), the pre-selection of primary models has to be renewed regularly. In this way, current trends in characteristics, e.g. towards larger or smaller size of cars within the bounds defining the consumption segments, are included.

As is noted in Chapter 6, in effect, resampling with chain linking works rather like the implicit quality adjustment method of bridged overlap. That is, differences in product characteristics between the two samples across a chain link are not shown as a price change in the index series. Nevertheless, replacement with quality adjustment should always be made when a priced product offer is no longer available or no longer representative, even when this occurs close to the next December and the next planned resampling.

In general the annual resampling should also involve a renewal or review of the sample of car dealers.

12.3.5.7 Leasing (Recommendation 7)

According to Annex II to Regulation (EC) No 1749/1999, purchases of motor cars also cover purchases through financial leasing arrangements. Guidance on how to include these purchases is given in ESA 2010 on the treatment of hire purchase (leasing):

> **15.20** *Hire purchase is a type of financial leasing.*
>
> *Definition: a hire purchase arrangement exists when a durable good is sold to a purchaser in return for agreed future payments. The buyer takes possession of the good immediately, though legally it remains the property of the lessor as collateral/guarantee until all agreed payments have been made by the lessee.*
>
> *[...]*
>
> **15.22** *In the case of hire purchase, the durable good is recorded as if acquired by the purchaser on the day they take possession of the asset at the market price that would have been realised in an equivalent transaction.*

According to the ESA, financial leasing involves the purchase of a car on credit by way of loan agreement with the provider of the car. As stated in paragraph 15.22, the price recorded for financial leasing (hire purchase) is the market price that would have been paid in an equivalent normal purchase (cash) transaction. To ensure a proper target sample it is important to take into account hire purchases. They should be classified under ECOICOP 07.1.1 (Motor cars).

In addition to this, there are *operating leases,* which cover the right to use a car for a specified term for a specified monthly payment. Such leases may include regular maintenance and servicing costs and may also include a maximum usage limit (km per year) as well as other conditions. After the agreed duration of the lease, the car is returned to the lessor and consequently no purchase takes place. This type of leasing resembles car rental where the rent would be the monthly payment for leasing the vehicle. This payment is affected by the contract duration, the annual mileage and the amount of the initial payment. Operating leasing should therefore be classified under ECOICOP 07.2.4 and not under ECOICOP 07.1.1.

The different treatment of these two types of lease contracts makes it necessary to determine the weights for the two categories. Information on how to do this, e.g. the percentage of types of financial leasing contracts, could be obtained from finance companies that provide loans for cars, or, in the case of operating leases, from the leasing companies themselves.

Furthermore, it is important to include cars bought for cash, which also includes purchases made with a loan from another institution such as the consumer's bank. While this is a purchase on credit, it is not a hire purchase agreement with the provider of the car as described above.

For financial leases and cash purchases, price collection should be undertaken as with any other good, i.e. the full price of the car is entered into the index in the month in which it is observed.

A possible approach for price collection for operating leases could be to select a representative set of car models and record the monthly payments (i.e. prices) for these models. Information about these payments can be found both on the websites of the car producers and on the websites of independent leasing companies. A representative combination of annual mileage, contract duration and the amount of the initial payment should be chosen as values for product specifications. More than one representative combination per model is also possible. It is suggested to set the initial payment to €0.00 in order not to confound this type of financial leasing with funding.

12.3.6 Explanatory text, second-hand cars

Overview

The circumstances for used cars and the application of the Recommendations are analogous to those for new cars. The differences are summarised below:

- The issue of excluding business cars is less relevant, as second-hand cars are less likely to be purchased for business use.

- Instead there is an issue of excluding purchases of used cars directly from other households, since these are not within the scope of the HICP.

- Stratification of used cars by the age of the car seems an appropriate approach to identify relevant strata. This is an additional differentiation to the identification of consumption segments.

- The role of quality adjustment is somewhat different, as discussed in section 12.3.1.

Purchase of vehicles includes purchases by households of new vehicles and net purchases by households of second-hand vehicles from dealers. Sales of second-hand vehicles between households are excluded. In the HICP, household expenditures include expenditures on second-hand cars (and in theory, if not in practice, other second-hand goods that are bought from dealers) while sales of second-hand cars to dealers are deemed a negative expenditure. Consequently, the weight for second-hand goods is based on households' *net* expenditures (i.e. the value of purchases minus sales).

The purchase and sale of second-hand cars among households on the economic territory will cancel out, meaning that the net weight is nil for these transactions. However, households also buy second-hand vehicles from dealers and garages for which the weights will not necessarily be negligible. In some countries, purchases of second-hand cars through these channels actually result in a weight for this category which is higher than that of new cars.

Although household final monetary consumption expenditure does include information on used car sales it may be grouped with the sales data on new car sales. If the aim is to construct a sub-index for second-hand cars (at the 5-digit level), then a weight for this sub-class will need to be defined, particularly if the price development of second-hand cars differs from that for new cars. Chapter 3 discusses the options for weights for new and second-hand cars

12.3.6.1 Stratification (Recommendation 1)

Stratification of used cars by the age of the car seems an appropriate approach to identify relevant strata. This is an additional differentiation to the identification of consumption segments.

The universe of primary models can be stratified according to country-specific age classes, with boundaries that are natural for the ownership changes in the national second-hand car market. This information can be obtained from the national car register.

To be pragmatic, the second-hand car market could for example be stratified according to the following or to some other pre-determined age classes that are representative of purchases within a Member State:

- 2-year-old cars (often the age at which former company/rental cars enter the second-hand market),

- 4-year-old cars,

- 6-year-old cars.

If older cars are common, additional strata may be needed. However, it should be noted that purchases between households are excluded from the HICP. Only purchases by households from companies are included, and these cars are likely to be no more than a few years old.

The consumption segments for second-hand cars are largely the same as for new cars.

The universe of primary models within the second-hand car market might be bigger than the new car population due to the fact that the second-hand car universe goes back in time and therefore contains primary models sold several years ago

Weighting of new versus second-hand cars

In principle, the weight for second-hand cars should be net of car sales from households to other institutional sectors.

When the weight for second-hand cars is established, given the two options in Annex II to Regulation (EC) No 2214/1996, the weight should be split over new versus second-hand cars according to expenditure shares (see

Chapter 3). These can be estimated by multiplying the number of ownership changes from the preceding year by an average price for new or second-hand cars, respectively.

12.3.6.2 Target sample (Recommendation 2)

It is generally suggested that stratification of second-hand cars is undertaken using two principal dimensions, namely age classes and primary models, using information from the national car register. A final step is to assign precise sub-models to each primary model.

The regional dimension could possibly be considered depending on national circumstances, e.g. if advertised prices are known to differ by region.

12.3.6.3 Price collection (Recommendation 3)

The selection of primary models and sub-models is similar to the approach for new cars (see section 12.3.5.1, Recommendation 2 above).

For second-hand cars, list or advertised prices are accepted estimates for transaction prices if the latter are not available.

In most cases, central price collection is appropriate. Regional price collection should only be considered justifiable if supported by evidence that prices differ by region.

In general, there are two alternative approaches for central price collection:

1. Observation of transaction prices or offer prices from a market research institute or trade magazine/website, the prices of which are based on actual recent sales;

2. Observation of offer prices from internet platforms or adverts in car magazines.

Using transaction data from a market research institute or a trade body may often be preferable as the data may be of a higher quality than is cost-efficiently attainable by a Member State given the weight for second-hand cars in the HICP. Another possibility is to use data from a market research institute that provides offer prices. In many European countries data is available from sites like Eurotax Schwacke and Glasses Guide, for example. Either way, it is important to check the quality of the data from a market research company at regular intervals.

If market research cannot be used, central price collection can be set up using internet platforms and car magazines or actual price collection at car dealers.

For central price collection the following principles should apply:

- It is necessary to refer to the same sub-model over time.

- The age in months should be held constant as far as possible.

- The mileage should be kept in the same order of magnitude, e.g. between 45 000 and 60.000 km.

- It is important to consider normal product offers, excluding offers from private persons, cars that have been involved in an accident, special exclusive editions and so on.

- If there is a large range of sub-models that fit all the mentioned criteria, any sub-model may be selected.

An alternative suggestion for a target sample

If the structures of the new car market and the second-hand car market are similar the following, simplified approach can be taken for the second-hand car sample.

Use the same sample of primary models for new cars for second-hand cars with an appropriate delay, e.g. two years.

This simple approach may only be used if the markets for new and second-hand cars are structurally the same, i.e. the same primary models that are sold as new cars are also sold as second-hand cars two years later.

12.3.6.4 Product replacement (Recommendation 4)

A peculiarity of the second-hand car market is that no price observation will refer to the same car because the values for the characteristics *age* and *mileage* will vary from observation to observation. This means that, in principle, in every period each observed second-hand car has to be replaced. In practice, the differences between the priced model age and mileage should be kept minimal and ranges for age and mileage should be used.

Representativity check within the scope of the monthly price collection

The concrete sub-models that were in the sample in the preceding month serve as a starting point for the price collection of the current month.

If the sub-model of the preceding month is no longer available it should be replaced. The replacement sub-model has to correspond as closely as possible to the primary model. The new sub-model should be:

- of the same primary model,

- of the same age class,

- of the same mileage dimension.

If the primary model significantly loses its market share within the consumption segment and age class, it must be replaced by a more representative primary model. This replacement primary model may — as with new cars — be of the same or an alternative brand. For the new primary model new sub-models in the corresponding age class have to be chosen.

12.3.6.5 Quality adjustment (Recommendation 5)

Quality adjustments for second-hand cars can be addressed in several ways. If data is obtained from market researchers, quality adjustments will depend on the actual data used.

If data is collected centrally by the Member State, either hedonic methods can be used or bridged overlap together with expert judgements.

A distinction between minor and fundamental changes helps to decide whether an explicit or implicit quality adjustment is necessary. In general, fundamental changes in the quality of second-hand cars are too complex for an explicit quality adjustment, whereas minor changes can be adjusted explicitly.

Minor changes in quality of second-hand cars can only occur when observing the same sub-model over time, as:

- the age of the car differs,

- the mileage of the car differs,

- changes in the equipment occur.

Fundamental changes in the quality of second-hand cars should be treated the same way as for new cars.

The case of minor changes

Minor quality changes in the equipment of a precise sub-model cannot be adjusted for explicitly since the value of a singular component of the second-hand car is unknown, and such minor features are less relevant to the user functionality of second-hand cars than new cars. In practice it is better to keep the observed second-hand car as similar as possible and either apply hedonic methods or direct comparison.

The case of changes in mileage or age — supported expert judgement

Changes in the age or in the mileage of the car should be adjusted by supported expert judgement. A supported expert judgement is calculated for each primary model and age class for the depreciation rate for age and for mileage. These depreciation rates are calculated on a yearly basis.

This means, for each primary model in each relevant age class two additional samples have to be collected: One sample to calculate a depreciation rate for age and one sample for mileage. The price observations of these two samples should refer to one specific sub-model and exclude cars that have been involved in an accident or are special in some other way.

To calculate a depreciation rate for the age of a particular primary model and in a particular age class, 10 used car prices should be observed. These 10 price observations consist of five pairs, each should be of the same sub-model, very similar mileage and of different ages within the range of the corresponding age class. It is important that the mileage of the observation pairs is very similar (nearly constant) whereas the age in months can vary within the interval of the considered age class.

On the basis of the first sample, a depreciation rate for the age in months can be calculated. Therefore, five depreciation rates for the five observation pairs have to be computed. These depreciation rates are averaged by the arithmetic mean. Thus, the calculation follows the equation:

$$\delta\ Model\ A, Age\ class\ Age = \frac{1}{5}\left(\frac{(P_1-P_2)}{(Age_2-Age_1)} + \frac{(P_3-P_4)}{(Age_4-Age_3)} + \cdots + \frac{(P_9-P_{10})}{(Age_{10}-Age_9)}\right) \tag{12.3.1}$$

The $\delta\ Model\ A, Age\ class\ Age$ can be interpreted to be the absolute monetary value of one month of age for the considered primary model in the considered age class.

Analogously, to calculate a depreciation rate for the mileage of a particular primary model and in a particular age class, a second sample of 10 second-hand car prices should be observed. These 10 price observations again consist of five pairs. Each should be of the same sub-model, identical age in months but of different mileages. Thereby the age between the pairs can differ within the range of the age class.

On the basis of the second sample, a depreciation rate for the mileage can be calculated following the equation:

$$\delta\ Model\ A, Age\ class\ Mileage = \frac{1}{5}\left(\frac{(P_1-P_2)}{(Mileage_2-Mileage_1)} + \frac{(P_3-P_4)}{(Mileage_4-Mileage_3)} + \cdots + \frac{(P_9-P_{10})}{(Mileage_{10}-Mileage_9)}\right) \tag{12.3.2}$$

The $\delta\ Model\ A, Age\ class\ Mileage$ can be interpreted as the absolute monetary value of an additional mileage of 1 000 kilometres for the considered primary model in the considered age class.

These model and age-class-specific depreciation rates can be used to adjust observed second-hand cars with different ages and mileages between months of observation

Caveats concerning supported expert judgement

Supported expert judgement for quality corrections for changes in mileage and age of second-hand cars are considered B methods. Caveats concerning the method are:

- The sub-samples collected for the calculation of the depreciation rates for age and mileage refer to the specific primary model and age class. Therefore these sub-samples are rather small (10 observations), possibly resulting in unreliable depreciation rates. The reason for this is that the collected offer prices can vary significantly, even for cars with very similar characteristics.

- Unavailability of observations with precisely defined characteristics (sub-model, equipment version, age and mileage) makes approximations necessary.

If data is obtained by a market research institute, no variations of the characteristics age and mileage may occur and, if so, no supported expert judgement has to be applied.

A hedonic method for second-hand cars – using hedonic re-pricing for minor changes

The following form of hedonic re-pricing (see Chapter 6) applies when prices for second-hand cars are collected from internet platforms or car magazines.

The identification of consumption segments for second-hand cars is described above.

Construction of a sample

To apply hedonic re-pricing in the form described here, usually two samples are used — the regression sample and the index sample.

The *regression sample* is used to calculate the hedonic regression equation. The *index sample* is used to calculate the price index for second-hand cars; it is constructed as described in Recommendation 2 above. The index sample may or may not be a sub-sample of the regression sample.

One possibility is to use websites as sources for both samples, as information on car prices and specifications is widely available online.

The sizes of the regression and index samples are country-specific, since the number of observations depends on the consumption segments and age classes. As a rule of thumb, at least 15 to 20 observations should be collected per characteristic in the regression equation. However, current data sources may allow the efficient use of many more observations.

The regression sample should contain all the selected primary models from the different consumption segments. There is only one regression sample for all consumption segments.

The case of minor changes — hedonic re-pricing

Minor quality changes in the equipment of a precise sub-model cannot be adjusted explicitly unless the feature is part of the hedonic function. In these cases no correction should be applied.

Changes in the age (in months) or in the mileage (in kilometres) of the car should be adjusted by hedonic re-pricing.

In order to ensure a reliable regression, additional variables have to be added that specify the selected primary models:

- Brand dummies (for brand cluster);

- Size dummies (for size cluster);

- Dummies for consumption segment.

The variable *brand cluster* can typically assume values of 1, 2 and 3 and divides the selected primary models according to the prestige or image of the brand. This variable serves as a proxy variable for the overall quality and the prestige of the models in order to reflect the difference between brands.

The variable *size class* can typically assume values of 1, 2 and 3 and divides the selected primary models within a consumption segment according to the size of the cars. This variable is normally needed as the models within a consumption segment are still heterogeneous with regard to their size.

Refreshing the hedonic function

The hedonic function should be updated regularly; a yearly update is sufficient unless market developments indicate otherwise, as there is no rapid technological development from month to month in existing second-hand cars.

Alternative hedonic method for second-hand cars — using hedonic re-pricing to adjust all transaction prices

A particular hedonic approach is applicable, and normally preferable, in environments where price data for all purchase transactions are available, usually from a market research company. Here replacements do not have to be identified to fulfil the aim of the regulation requirements. Namely, quality adjustments by hedonic re-pricing are applied to the prices for all purchase transactions in the transaction universe for the product group in question. Stratification is usually not needed as the regression equation handles differences that occur in the most important price-determining characteristics, which for second-hand cars are age and mileage. The monthly computation is in principle well-defined so that it can be made automatic.

The method works as follows. Separate regression equations are calculated for each of the primary models or low-level clusters of primary models. The regression equations are of semi-logarithmic form with only two explanatory quality variables, namely model age and mileage. This regression analysis is usually based on the observed purchase transaction data for the price reference period, i.e. the preceding December. The regression coefficients for age and mileage thus calculated are then used to adjust the prices in the monthly index calculations. That is, both reference

and comparison prices are adjusted to correspond to the same age and mileage, so that they become comparable, undisturbed by any change in age or mileage. Then the elementary aggregate index is computed from the set of adjusted prices.

12.3.6.6 Annual resampling (Recommendation 6)

In addition to the representativity checks conducted within the scope of price collection within a year, the representativity of the sample should also be checked during the annual resampling in December.

12.4 Actual rentals

12.4.1 Introduction

The measurement of changes over time in actual rentals paid by tenants requires particular attention owing to the relatively high weight of these rents in the HICP of most countries.

The treatment of actual rentals has to recognise that rental markets are in several ways heterogeneous within and between European countries, mainly owing to differences in market and legal environments as well as in consumer preferences. These differences are reflected, for example, by variations in the quality of dwellings and in the terms and conditions of the rental contracts.

HICPs for actual rentals should cover all types of residential properties for rent, including private, public and social rental units, and new and existing rental contracts. For example, rentals may or may not be freely negotiated between the landlord and tenant, and they may or may not be subsidised or somehow restricted. Imputed or estimated rentals for owner-occupied housing are not within the scope of the HICP, as they do not involve any monetary transaction.

The following recommendations specify how to measure changes in prices of actual rentals in the HICP. These recommendations focus on sampling and quality adjustment issues. The explanatory text elaborates on the identification of consumption segments, the construction of a representative target sample, quality adjustment methods and replacement strategies.

12.4.2 Recommendations

Whereas ([131]*)*

The coverage of the HICP means the set of all transactions falling within the scope of Household Final Monetary Consumption Expenditure. The target samples shall have sufficient elementary aggregates to represent the diversity of items within the category.

Applying these rules to actual rentals, they shall cover all types of rental properties for housing, i.e. social rents and market rents, new and existing rental contracts.

Recommendation 1: Stratification

The population should be stratified in accordance with those variables which are most correlated with the rental (price) development. There should at least be stratification according to the regional dimension.

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[131] See Regulation No 1749/96, Article 2(3) and Article 8. See also: http://ec.europa.eu/eurostat/documents/272892/7048317/HPI-HICP+Recommendations+on+the+treatment+of+rents+-+June+2015

Recommendation 2: Consumption segments

The variables:

- type of dwelling,

- size category, and

- type of contract

are appropriate for the definition of consumption segments.

Recommendation 3: Sampling

Sampling of rental contracts for housing can be conducted by tracing dwellings, landlords or households. Random sampling with at least partial annual renewal (resampling) should be applied.

Recommendation 4: Replacements of dwellings

When a dwelling is replaced, the replacement should belong to the same stratum and consumption segment and should be as similar as possible to the replaced dwelling with regard to auxiliary variables.

Recommendation 5: Quality adjustments

Price (rent) changes that occur together with tenancy changes should be reflected in the index. If there is no change in quality, direct comparison should be considered an A method.

If a quality adjustment is needed, a hedonic approach is considered an A method and bridged overlap a B method. When using bridged overlap, targeted mean imputation is preferred. Supported judgemental quality adjustment can be used as B method under the condition that it is possible to determine the absolute value for the quality change.

Recommendation 6: Secondary residences

Rentals paid by tenants for secondary residences on the basis of long-term contracts should be allocated to COICOP 04.1.2, while rentals paid by tenants for short-stay accommodation in secondary residences should be allocated to COICOP 11.2.0.

12.4.3 Definitions and concepts

The following guidance on actual rentals applies equally to all kinds of rental units, whether owned privately, by government bodies or by non-profit organisations, and whether or not the rental prices are social rentals set with the intention to be affordable for some categories of tenants.

For actual rentals for housing (shelter), the following definitions apply in line with Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices:

Product offer: is interpreted as the rental contract for housing between a specific landlord and a specific tenant.

Product: the provided service, specified in the rental contract as the rental unit, usually involving a specific dwelling.

Physical product: the rented dwelling with associated services.

Target sample: is the set of rental contracts for which the Member State plans to observe rental prices from which a reliable and comparable representation of the residential rentals will be achieved within its economic territory.

Further the following definitions apply:

Social rentals: are rents that are not freely negotiated between tenant and landlord but are subject to public regulation in some form, usually put in place in order to provide affordable shelter for some categories of tenants.

Repairs and maintenance: are activities that have to be taken to maintain the normal functionality of the dwelling. They can be seen as an activity to offset the wear and tear from using the rental unit. Such activities do not imply changes in the dwelling's performance, capacity or expected service life. They do not provide improvements or changes in functionality, and thus they are not deemed as quality changes (in the sense of Regulation (EC) No 1749/96 Article 2(16). Examples include repainting interior walls, or like-with-like replacement of kitchen appliances and furniture (if included in the rental contract) with new appliances and furniture of similar functionality.

Modernisation and additions: are activities that provide improvements in the functionality of the dwelling or the building, and thus they are deemed as quality changes (in the sense just mentioned).

This covers activities such as:

- modernisations that add new features,
- improvements,
- reconstruction, and
- enlargements.

Table 12.4.1 summarises the distinction between repairs and maintenance, and modernisation.

Table 12.4.1: Summary of distinction between repairs and maintenance and modernisation

Type of activity	Frequency	Aim	Carried out by	Examples
Repairs and maintenance	Regular	To maintain functionality	Landlord and/or tenant (depending on national customs and the rental contract)	Painting; changing wallpaper; replacing worn carpets and furniture; replacing broken light fittings; replacing a broken windowpane.
Modernisation and additions	Occasional	To improve functionality	Landlord	Replacing a kitchen or bathroom; changing functionality; improving insulation; replacing old windows with double- or triple-glazed windows for which the insulation and noise mitigation qualities are better; adding a garage or an extra toilet; adding glass walls or panels added to a balcony.

The various methods used for applying quality adjustment are described in Chapter 6.

12.4.4 Legal requirements for the HICP

Actual rentals are all rents paid by tenants regardless of whether the dwelling is publicly or privately owned. This includes the full amount of the rent the tenant pays to the landlord regardless of any social benefits the tenant receives from public authorities. According to the definition of household final monetary consumption expenditure used in the HICP, housing payments made by public authorities to tenants to reduce their rents are considered to be social benefits in cash and therefore enter into household's disposable income. This means that the full rent should be covered by the HICP, without deducting the cash benefits.

Actual rentals normally include payment for: the use of the land on which the property stands; the dwelling occupied; fixtures and fittings for heating, plumbing, lighting, etc.; and, in the case of a furnished dwelling, furniture.

In principle, the price that enters the index should, if possible, exclude additional charges, such as charges for water supply (ECOICOP 04.4.1), refuse collection (ECOICOP 04.4.2) and sewerage collection (ECOICOP 04.4.3); co-proprietor charges for caretaking, gardening, stairwell cleaning, heating and lighting, maintenance of lifts and refuse disposal facilities, etc. in multi-occupied buildings (ECOICOP 04.4.4); charges for electricity (ECOICOP 04.5.1) and gas

(ECOICOP 04.5.2); charges for heating and hot water supplied by district heating plants (ECOICOP 04.5.5). In practice, landlords in some countries may include some of these charges in the rental. In such cases, the weights and indices concerned should, if possible, be adjusted according to the principles stated in Section 7.6 (treatment of bundles). If the prices of additional services cannot be identified separately, then no adjustments should be made.

In ECOICOP, actual rentals for housing are defined as follows:

04.1.1 Actual rentals paid by tenants

04.1.1.0   Actual rentals paid by tenants

*Includes***:**

- Rentals actually paid by tenants or sub-tenants occupying unfurnished or furnished premises as their main residence.

- Payments by households occupying a room in a hotel or boarding house as their main residence.

*Excludes***:**

- Garage rentals (04.1.2.2).

- Accommodation services of educational establishments and hostels (11.2.0.3).

- Retirement homes for elderly persons (12.4.0.2).

04.1.2 Other actual rentals

04.1.2.1   Actual rentals paid by tenants for secondary residences

Includes:

- Rentals actually paid for secondary residences.

Excludes:

- Accommodation services of holiday villages and holiday centres (11.2.0.2).

04.1.2.2 Garage rentals and other rentals paid by tenants

*Includes***:**

- Payment for the use of a garage to provide parking in connection with the dwelling. The garage does not have to be physically contiguous to the dwelling, nor does it have to be leased from the same landlord.

*Excludes***:**

- Payment for the use of garages or parking spaces not providing parking in connection with the dwelling (07.2.4).

Actual rentals cover expenditures for a housing service, including a room in a hotel or boarding house if the purpose is to occupy it as a main residence. Rentals or payments for accommodation services in holiday centres and villages are excluded. These are classified in ECOICOP 11.2.0.2.

12.4.5 Explanatory text

12.4.5.1 Stratification (Recommendation 1)

Strata should be designed so that the expected development of rental prices is relatively homogeneous within strata, so as to provide for representativity and precision. It is recommended to stratify the sample at least along a regional dimension, using a sufficiently detailed breakdown of locations, and to include geographical divisions of the country in the sample. Additionally, social rental units should be separated from other rental units in the

stratification. Strata should be weighted in relation to their relative expenditure shares, with due regard to the sampling design.

Weights for strata should preferably be calculated from national accounts expenditure data if available. If national accounts data cannot be broken down to the stratification, approximate weight calculations can be made from other data sources, such as population census data, household budget surveys or household economy data, e.g. from EU-SILC ([132]). For example, estimated stratum weights could be taken in proportion to the stratum population multiplied by an estimated proportion of renters in the stratum population, and an estimated average rent level in the stratum.

12.4.5.2 Consumption segments (Recommendation 2)

For the definition of consumption segments, see Chapter 4.

The definition of consumption segments should be based on the intended or predominant use of rental units. This is generally determined by the type and size of dwellings, for example large detached houses are normally considered to be family homes, whereas one-bedroom flats in a tower block are generally intended to be rented to either single people or couples with no children, and so on. Clearly tenants do not consider all dwellings to be equivalent, as a dwelling's essential characteristics differ widely from one rental unit to another.

The definition of consumption segments for actual rentals may ultimately depend on consumer perception and the market environment in the country in question. As a general rule, the following criteria are likely to be relevant for defining consumption segments:

- **type of dwelling** — flat, terraced house, semi-detached house, detached house etc.;

- **size** — in either number of rooms, number of bedrooms, floor area, or small/medium/large, etc.

- **rental conditions** — social rent, market rent, student homes, rentals aimed at non-national residents (expatriates), etc.

- **location** — in cases where the sampling strategy requires that the sample follows the tenants when they move; see explanations of Recommendations 4 and 5 below.

The definition of consumption segments determines where replacement dwellings should be selected.

12.4.5.3 Sampling (Recommendation 3)

Sampling frame

Generally, there are three possible sources of data from which a sampling frame can be created:

1. from a register of dwellings (addresses),

2. from a register of households (tenants), or

3. from a register of landlords.

A *register of dwellings* may in many cases be obtained from land registry offices or a dwelling census. These data sources often contain information on some of the criteria that can be used for defining the consumption segments such as type of dwelling and size in addition to geographical location, normally down to micro-location of the dwelling, as defined by street address or postal code. Random sampling can be used. An important drawback with a register of dwellings is that it will often not contain any information about tenancy, i.e. whether the residential property is rented or owner-occupied. Consequently, the drawn sample must be filtered in this respect. A limitation in some cases is that the register may contain information on buildings as a whole and not information on the particular rental units within a building if these have been sub-divided into flats.

([132]) http://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database

The precise form and contents of a sampling frame based on a register of dwellings may vary between countries according to the data present. For a rough approximation, see Table 12.4.2.

Table 12.4.2: The form of a typical dwellings register

Region 'X'							
Dwelling identity	Address of the building	Type of building (single-dwelling/ multi-dwelling, etc.)	Other data for the building (year built, etc.)	Number of rooms in the dwelling	Floor area in the dwelling	Type of kitchen (normal/ kitchenette, etc.)	…
…							
…							
…							
…							

A *register of households* may sometimes be a practical solution as the sampling frame could be obtained from a register of residents, or possibly from a recent population census. Random sampling can be used. However, the sampling precision in the measurement of price change is impaired by the artificial jumps in prices that occur if households move to other rental dwellings with very different rents.

A sampling frame of this kind may contain only a limited amount of regional information but no other important information, such as the size of the dwelling. Moreover, as in the case of the register of dwellings, there may be no information on whether the dwelling is rented or owner-occupied, which requires the drawn sample to be filtered before it can be used to define the target sample.

Another drawback is that these registers may not be up to date if the locations happen to be characterised by high turnover rates, which is often the case among young, single and unattached tenants or in areas where short-term lettings predominate. However, the approach of following a sample of tenants has been proven to be cost-effective in some countries.

An alternative to registers of dwellings and households, which by definition may also include owner-occupied dwellings, is a *register of landlords*. This has the practical advantage that it is directly applicable as a sampling frame as it refers only to rental units.

A drawback may be that private households who rent dwellings directly to the household sector, which can be a significant portion of the rental market in some countries, are often not covered by such registers. Companies or other bodies that rent buildings to the business sector have to be filtered out, so the register cannot always be used unaltered as a sampling frame. Additionally, a register of landlords may not provide information on the locations of dwellings, which would limit the possibilities for efficient sampling. Finally, a sample of dwellings from large property rental companies may be too homogeneous compared with the actual rental market to provide a representative sample, and so may not fully reflect true price developments in any specified region or location.

The three different approaches to designing sampling frames have various advantages and disadvantages and probably no single approach can be described as *best practice* owing to the different market environments in each country. Overall it may be preferable to track dwellings rather than tenants (households). This is because any quality differences in the two rental units the tenant moves between can be difficult to adjust for. However, the choice of an appropriate sampling frame depends primarily on national circumstances and the availability of data.

Selection of sample units within selected strata

Selecting sample units, i.e. rental contracts, by *probability samplin*g requires the availability of a sampling frame, which is in this case a complete register (list) of sampling units within each stratum. A practical limitation is that the register may not include all relevant stratification variables, so proxy variables may have to be used instead. For example, a coarser geographical sub-division may have to be used instead of a preferred finer one.

Probability sampling provides a truly representative selection, but only if the coverage of the sampling frame is accurate. It does not eliminate the need to filter the sample if the frame includes irrelevant units, such as the contracts of non-household tenants (e.g. commercial tenants) or owner-occupied dwellings.

Purposive sampling may be advisable if the rental market is very small and geographically-dispersed and a sampling frame is not available. For example, in countries where a large majority of households are owner-occupiers, a complete a list of rented dwellings, tenants or landlords may not be available.

A pre-condition for purposive sampling is that the price statistician has a general idea of the rental market within the strata. A significant weakness of purposive sampling is that the selection of dwellings is determined by the decision maker, therefore running the risk of *convenience sampling*, i.e. selecting rental units that are easy to observe, leading to a selection bias problem.

Cut-off sampling appears to be less appropriate if the sampling frame is based on a register of dwellings or a register of households.

Cut-off sampling should normally only be considered if the sampling frame is based on a register of landlords where the market is dominated by a few major landlords. For example, in the case of student lodgings or some types of social housing. The choice of which large landlords to include in the sample could be based on the number of dwellings or the total floor area of all dwellings provided by the landlord. Such a method may be sufficient in market environments where rents move similarly for both smaller and for larger landlords within both the market and social rental sectors respectively. However empirical evidence, particularly for the market rental sector, may be needed to verify this assumption if this approach is used. The method may also be suitable if the excluded part is obviously of very little importance in the consumption segment as a whole.

Frequency of sample refreshing

To ensure that the sample of rentals remains representative, it should be reviewed and updated annually, at least in part. The sample should be fully renewed at least every five years, in line with Recommendation 3.

Other sampling options — cases of small rental markets, lack of sampling frames

In some countries, the rental market may be of relatively minor importance and consequently the weight for rentals is relatively small. In these markets there may not be any registers of rental units or tenants. In such cases, a coarser approach can be considered, such as using an area frame and purposive sampling. For example, one possibility is to use a purposive sample of publicly advertised rentals in a sample of locations or residential districts (area sampling).

If a sample of advertisements is used, some approximate adjustments should be made in the weighting scheme to compensate for the differences in the probability of selecting contracts of different durations. In other words, short-term contracts are likely to be overrepresented in the sample compared with long-term contracts, as the rental units in question become vacant on a more regular basis and so are advertised more frequently.

Coarser approaches such as this naturally add some undesirable uncertainty, but the impact of the latter is limited if the rental weight is small and the market mechanisms for setting rents are free from regulation.

The following table gives a very basic overview of the main options for sampling frames and sampling methods. Regardless of the method chosen, it is important to ensure adequate coverage of new and existing contracts, social rentals, market rentals, rentals made to residents and to non-residents and agreements with private landlords. Table 12.4.3 also includes replacement strategies, which are discussed in the next section.

Table 12.4.3 Options for sampling frames and sampling methods

Sampling frame	Sampling frame variables	Typical sampling method	Replacement strategy	Notes
Register of dwellings	Dwelling characteristics	Probability sampling	Tracing (tracking) dwellings	Often preferable
Register of households	Household characteristics	Probability sampling	Tracing (tracking) tenants or dwellings	May be less efficient
Register of landlords	Does not have all the desirable variables	Cut-off sampling	Tracing (tracking) dwellings	For student lodgings, etc.
Other: area frame, etc.	Does not have all the desirable variables	Purposive sampling	Tracing (tracking) tenants or dwellings	Can be considered for countries with small rental market

12.4.5.4 Replacements (Recommendation 4)

The following replacement approaches are possible for rentals:

Tracing (tracking) tenants: When a sampled tenant (household) moves, the replacement rental contract should be for the dwelling to which the tenant has moved.

Tracing (tracking) dwellings: In the case of a sampled dwelling, the sample of dwellings is normally kept fixed until a resampling takes place, such as during an annual review. Between annual reviews, when a tenant leaves, the contract for the new tenant of the sampled dwelling is taken as the replacement.

As stated above, it may be preferable to track dwellings instead of tenants (households). This is because any quality differences between the two rental units the tenant moves between can be difficult to adjust for. However, the approach of following a sample of tenants is permitted (if appropriate quality adjustment methods are used).

When tracing or tracking dwellings, a change in the rent level is often linked to a change in tenancy. That is, the landlord often adjusts the rent to current market conditions (supply and demand) when a new tenant moves in. The price change that is observed in such situations — which may or may not be quality-adjusted to reflect any improvements made by the landlord before a new tenant moves in — can be significant and has to be reflected in the price index. This kind of price dynamic, which is specific to the private rental market, should be kept in mind when defining the treatment of temporarily vacant dwellings in the sample. If prices for temporarily vacant dwellings are imputed, then it is advisable to use the prices of new rather than existing rental contracts, so as to capture this type of price dynamic.

In practice, the choice between the tracking options in replacements is closely related to the form of the sampling frame, covered in the previous section (Recommendation 3) above. If a register of dwellings is used as sampling frame, it is naturally efficient to track dwellings, and likewise if a register of landlords is used. If a register of households is used, it may be practical to track tenants, but it could also be possible to track dwellings.

12.4.5.5 Quality adjustment (Recommendation 5)

Quality adjustment will in general be required when there is a replacement situation (between annual resampling), either when there is a change of tenants for a given rental unit or in the case of replaced dwellings for a given tenant.

Quality adjustment may also be needed during ongoing occupation of the dwelling by the same tenant if a modernisation occurs. To enable quality adjustment, information on quality changes should be collected during price collection.

A particular problem for index compilers is distinguishing between regular repairs and maintenance and modernisations. In practice, there may be borderline cases. The main criterion in distinguishing between regular repairs and modernisation is that regular repairs and maintenance do not change the functionality of the rental unit, while modernisation does (see section 12.4.3).

Modernisations are not mere offsetting actions to counteract the effects of wear and tear; they lead to an improvement or change in functionality of the rental unit. Examples of such measures are an additional bathroom or toilet, the addition of a conservatory or garage, improvements to the heating or ventilation system by adding more radiators or air-conditioning units, etc., improvements to heat or noise insulation, or renovations to the balcony where glass walls are added, etc. If kitchen appliances are included in the rent, another example would be the addition of a considerably larger refrigerator. A major renovation of the bathroom is a quality change to the extent that it changes the intended functionality, e.g. by replacing a bathtub with a shower unit (which could be viewed as a reduction in functionality). For rented dwellings, as for any other consumer product, fashion trends are not considered quality changes.

Over time, the technology used in heating, cooling and lighting systems and home appliances has evolved. In particular, modern appliances are more energy efficient. If new, more efficient appliances replace old ones like-with-like as part of the regular maintenance of the dwelling, there is an implied modernisation.

However, if there is no change in the basic functionality of the dwelling, i.e. no radiators are added, or the replacement boiler supplies the same amount of hot water, these changes should not be treated as modernisations because no additional functionality has been added to the rental unit.

A further indicator given in the explanatory notes to ECOICOP is that regular repairs and maintenance are often (but not always) carried out by the tenant, while modernisation is always carried out by the owner.

The dividing line between repairs that maintain the functionality of a dwelling and modernisations that improve the functionality of the dwelling is not always clear-cut. Judgements need to be made, preferably supported by information on the repairs or improvements undertaken.

Ultimately, this distinction has to be made by each country in light of what the market perceives as modernisation and what is a mere repair of an existing dwelling.

For actual rentals, quality adjustment methods are classified as follows (on a case-by-case basis):

Approaches to quality adjustment during the occupation of dwelling

1. Regular repairs and maintenance serve to maintain the functionality of the dwelling and thus do not result in a quality change. Direct comparison, i.e. no quality adjustment, should then be considered an A method. Bridged overlap is classified as a C method.

    Reasoning: Repairs and maintenance do not change the dwelling's basic functionality, rather they preserve it. The age of paint and wallpaper, within a normal range, does not really affect the use of the dwelling. Furthermore, to the extent that any functionality would be lost by wear and tear, and would be regained by repair and maintenance, such variations may be disregarded, as they are likely to be small and tend to cancel one another out over time and over rental contracts.

2. Modernisations (major changes) imply that some relevant quality changes have occurred. For example, installing a new central heating system with more radiators or adding an air-conditioning system. In this case, hedonic regression is considered an A method, while bridged overlap and supported judgement quality adjustment are B methods.

    Reasoning: A modernisation will change some major characteristics of the dwelling. As such, the new rental price cannot be compared directly with the previous one since the tenant benefits from additional functionality as a result of the improvements made to the rental unit.

    Bridged overlap can be used where actual rentals are not regulated and are set in accordance with current free market prices. It may also be more straightforward to apply in practice. However, bridged overlap may be inappropriate where rents are subject to some form of regulation (e.g. social rents, or where rent controls exist); so that they do not reflect what tenants would be willing to pay for the rental units in view of their characteristics. Namely, bridged overlap works on the condition that prices are freely negotiated so that they correspond to consumers' valuation of quality (see Chapter 6). The preferred solution when using bridged overlap should be the targeted mean imputation technique, where imputed price changes are based on price changes for similar rental units.

    Hedonic methods, although an A method, have to be applied with some care, as international practical experience of applying hedonic regression to rentals may still be limited. Hedonic methods require that detailed information on price-determining variables be readily available, along with the requisite technical expertise to establish and maintain the hedonic models.

    Supported judgement quality adjustment can be used if it is possible to estimate a monetary value for the quality change. However, the alternative of taking the whole difference in price as an estimate of the quality change is not allowed (see Chapter 6).

Quality adjustment when a tenant changes (dwelling fixed)

   a) Price (rental) changes occurring at the same time tenancy changes should be reflected in the index. Where no quality change occurs, direct comparison should be considered an A method. Bridged overlap is classified as a C method.

   b) Where repairs and maintenance are carried out at the time of tenant changes, (e.g. redecoration) direct comparison should be considered as an A method, based on the same reasoning used for (1) above.

c) Where modernisation is carried out, hedonic regression is considered an A method, and bridged overlap and supported judgemental quality adjustment as B methods. See (2) above for the reasoning.

Selection and quality adjustment of replacement dwellings (tracing/tracking dwellings or tenants)

Dwellings have to be replaced due to building modernisations, demolition, rededication to other uses, permanent non-response or when tenants have either moved to another rented property, cannot be tracked anymore or have become owner-occupiers. A replacement dwelling should belong to the same consumption segment and stratum. Differences in the price-determining characteristics, e.g. in the size of the usable floor area, should be dealt with by applying one of the quality adjustment methods described above.

Table 12.4.4 summarises the conditions for, and suitability of, different quality adjustment methods for rentals.

Table 12.4.4: Summary of quality adjustment methods

Conditions		Suitable quality adjustment method
If there is no quality change		Use direct comparison
If quality changes occur	If a hedonic approach is feasible and practical	Use a hedonic approach
	Otherwise: if rents are freely negotiated	Use bridged overlap or, if feasible, use a supported judgement approach
	Otherwise: if rents are regulated	Use a supported judgement approach

12.4.5.6 Secondary residences (Recommendation 6)

According to the explanatory notes of ECOICOP rentals paid by households for a *secondary residence* for the duration of a holiday are allocated to 04.1.2, while all other expenditures concerning accommodation services for holiday purposes are allocated to 11.2.0.

In order to avoid this classification rule being interpreted differently across countries, the following guidelines should be followed:

- Rentals actually paid for short-stay accommodation for the duration of a holiday (covering both main and secondary residences) on the basis of a short-term contract are allocated to 11.2.0.

- Rentals actually paid for secondary residences on the basis of a long-term contract, such as on an annual basis, are allocated to 04.1.2.

12.5 Flights and package holidays

12.5.1 Introduction

Flights and package holidays present a serious challenge to index compilers as they are subject to a type of sliding pricing structure, dependent on how far in advance they are booked and on availability.

Strong seasonal patterns in both package holidays and some flight routes further complicate the measurement of prices for these services.

Moreover, the internet has revolutionised the way consumers now purchase flights and package holidays. Internet sales are growing steadily and often are now more important than traditional purchases at high street travel agents. Additionally, the growth of accommodation booking websites has led to many consumers arranging their own bespoke holidays where flights are booked separately from accommodation etc.

As a consequence, the recommendations on the treatment of cross-border internet purchases (see Section 7.2) in the HICP are of particular relevance for flights and package holidays, namely the recommendation that the price

observation for a tangible service bought on the internet must be accounted for in the Member State where the service is supplied.

In some countries, tickets for rail travel, coach travel or for sea fares/boat trips can also be subject to a type of sliding pricing structure, dependent on how far in advance tickets are booked and on seat availability. As such many consumers choose to book in advance either in person or on the internet to obtain the best fare. These websites often charge booking, delivery and text notification fees etc. Thus, the recommendations for flights and package holidays and the practical advice given in this chapter are also pertinent to internet-booked train fares and sea fares.

This section of the manual starts with the recommendations themselves and then expands on their provisions to provide practical advice for index compilers.

12.5.2 Recommendations

I. Airfares

Recommendation 1: Coverage

The expenditure (weight) and the price for airfares booked and paid for in a high street travel agent should be entered in the HICP of the Member State where the purchase is made.

The expenditure (weight) and the price for airfares booked on internet should be entered in the HICP of the Member State from which the flight first departs.

Recommendation 2: Price collection

The prices should be recorded sufficiently in advance of departure to ensure they are representative of consumers' expenditure and behaviour. In addition, the expenditure share of last-minute deals should be investigated and, if significant, included in the index.

Price collection should occur over a period of more than one working week if prices are known to be volatile within the month.

Recommendation 3: Price definition

Prices to be recorded should be the total cost of the service. This is the basic price of the service plus any additional costs necessarily included with the delivery of the service, such as booking fees and fees for using a credit card — where the latter characterises a representative product offer. The item descriptions should clearly specify which additional costs are to be included.

II. Package holidays

Recommendation 1: Coverage

The expenditure (weight) and the price for package holidays booked and paid for in a high street travel agent should be entered in the HICP of the Member State where the purchase is made.

The expenditure (weight) and the price for package holidays booked on internet should be entered in the HICP of the Member State where the package holiday first starts.

Recommendation 2: Price collection

The prices should be recorded sufficiently in advance of departure to ensure they are representative of consumers' expenditure and behaviour. In addition, the expenditure share of last-minute deals should be investigated and, if significant, included in the index as additional items.

Recommendation 3: Price definition

Prices to be recorded should be the total cost of the service. This is the basic price of the service plus any additional costs necessarily included with the delivery of the service, such as booking fees and fees for using debit or credit cards — where the latter characterises a representative product offer. The item descriptions should clearly specify which additional costs are to be included.

12.5.3 Definitions

Airfares: are that part of the price which accounts for the flight excluding fuel surcharges and taxes. In this chapter *flights* (and their prices) refer to the total cost of the service including any additional charges directly associated with the delivery of the service such as taxes, fuel surcharges, booking and credit/debit card fees etc.

Package holidays: are defined as those holidays where the cost of travel and accommodation are 'bundled' and sold in *one transaction.* Travel and accommodation bought in separate transactions do not represent a package holiday and their relevant prices and weights should be allocated to ECOICOP 07.3.3 (Passenger transport by air) and ECOICOP 11.2 (Accommodation services) respectively. The vast majority of package holidays will start with travel from the country of residence, while the consumption of the respective services can take place in multiple countries (see also Section 12.5.4).

Last-minute deals: are a marketing approach more typical for package holidays than flights, where tour operators try to sell unsold holidays, often at large discounts close to the date of departure in order to minimise their losses arising from unsold flights/holidays. There is no agreed definition of what period in advance of departure *last minute* represents. A working definition could perhaps be: departure within 3 weeks of the price collection day. However, further research at national level is required to assess the practicality of this definition.

Representative product offers: it is common practice within much of the travel industry that advertised prices of both flights and package holidays are generally less than the actual final prices paid by most consumers. This because, additional services such as baggage fees, priority boarding, extra legroom seats and in-flight meals etc. are often optional and are subject to additional fees. In addition, many airlines and tour operators levy compulsory booking fees and charges for using credit and or debit cards. All additional charges which are typically bought by consumers should be part of the product description to ensure that the product offers priced are representative of the total price paid by consumers.

12.5.4 Explanatory text

12.5.4.1 Coverage (Recommendation 1)

The coverage concept of the HICP is set out in Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, Article 2(20). The coverage of Household Final Monetary Consumption Expenditure as adapted for use in the HICP is termed the *Domestic concept* or *Domestic principle* (see Chapter 2 for a full description).

While the application of the domestic concept poses significant challenges in practice, its application is important to ensure that meaningful and consistent aggregate indices are made. In terms of the correct allocation of both expenditures and prices for flights and package holidays this concept is important and has a direct bearing on where such expenditures should be allocated.

The recommendations on the treatment of cross-border internet purchases (see Section 7.2) in the HICP state that for goods, the HICP should cover all internet purchases which are available for purchase within the economic territory of a country (prices and expenditures) regardless of the residential status of the seller. On the purchase of services the recommendation is as follows:

> *'The expenditure and the price observations for services of a tangible nature (services connected to immovable property, passenger transport, services in respect of admission to cultural, artistic, sporting, scientific, educational, entertainment and similar events, restaurant and catering services) booked through internet shall be accounted for in the country where the service is supplied.'*

Following the above, for purchases made via the internet, Recommendation 1 states that:

> *'The expenditure (weight) and the price for airfares [and package holidays] booked on internet should be entered in the HICP of the Member State from which the flight* [or holiday] *first departs'.*

In most — but not all cases, this will equate with the country of residence.

For all travel and holiday services booked through traditional high street travel agents, both the expenditures (weight) and the prices should be entered in the HICP of the Member State where the purchase is made. In addition, traditional travel agents also provide value-added services to consumers by offering advice and searching for the best deals and making bookings on their behalf. For their services, agents charge, implicitly or explicitly, a booking fee which forms a component of the recorded price.

Thus Recommendation 1 — Coverage, for both airfares and package holidays states that:

> *'The expenditure (weight) and the price for airfares* [and package holidays] *booked and paid for in a high street travel agent should be entered in the HICP of the Member State where the purchase is made.'*

Flights from smaller Member States to long-haul destinations such as the USA or Australia etc. or flights to a remote region within a larger country, for example a flight from London to the Outer Hebrides in Scotland, may involve multiple flights either within a Member State, or in more than one Member State. In which Member State should the expenditures and prices for these flights be recorded?

- If all flight segments of the flight are booked at a high street travel agent, then the expenditures and prices should be recorded in the country of residence of the travel agent.

- If all flight segments are booked via the internet as *one* transaction, then the expenditures and prices should be recorded in the Member State where the first flight segment starts.

- If the flight segments are purchased on the internet in separate transactions, then the expenditures and prices should be recorded in the country in which each flight segment starts.

This differential clearly has impacts on the definition of representative product offers and for price collection (see also Section 12.5.5.2 Sampling).

Examples of where prices and expenditures in terms of flights and package holidays should be allocated are given below.

Coverage examples: in which country should prices and expenditures be recorded? Some examples.

The examples below are taken from the recommendations and give some practical guidance:

1. A Danish consumer purchases via the internet a flight from Kastrup Airport (DK) to Heathrow (UK), the expenditure and price observation form part of the DK HICP.

2. A Danish consumer purchase via the internet a flight from Kastrup Airport (DK) to JFK (USA) via Heathrow (UK), the expenditure and price observation form part of the DK HICP.

3. A Danish consumer purchases via the internet a flight from Heathrow (UK) to JFK (USA), the expenditure and price observation form part of the UK HICP as this is where the service first commences.

4. A Danish consumer purchases at a high street travel agent in Berlin a flight from Heathrow (UK) to JFK (USA), the expenditure and price observation form part of the DE HICP as this is where the purchase is made.

5. A British consumer purchases via the internet a package holiday to Disneyland in Florida (USA) departing from London Gatwick, the expenditure and price observation form part of the UK HICP.

6. A British consumer purchases via the internet a Mediterranean cruise departing from Southampton (UK). The expenditure and price form part of the UK HICP.

7. A British consumer purchases via the internet a Mediterranean cruise departing from Athens (EL) and books flights to Athens separately. The expenditure and price for the flight form part of the UK HICP while the expenditure and price of the cruise forms part of the Greek HICP.

8. A British consumer purchases at a high street travel agent in Paris (FR) a Mediterranean cruise departing from Barcelona (ES) and purchases via the internet a flight from London (UK) to Barcelona separately. The expenditure and price for the flight form part of the UK HICP, while the expenditure and price of the cruise forms part of the FR HICP.

In each of these examples the potential data sources should always be kept in mind. See Section 12.5.5.1.

Flights (Airfares)

Flights are covered in ECOICOP in:

07.3.3   Passenger transport by air

07.3.3.1 Domestic flights

07.3.3.2 International flights

As specified above, the following ECOICOP sub-classes should also be covered by the Recommendations outlined here:

07.3.1.1 Passenger transport by train

07.3.4.1 Passenger transport by sea

Package holidays

The definition of package holidays used in these recommendations follows ECOICOP:

09.6.0   Package holidays

All-inclusive holidays or tours, which provide travel, food, accommodation, guides, etc. This includes: half-day and one-day excursion tours; pilgrimages.

09.6.0.1 Package domestic holidays

– Holidays taking place on the economic territory where the holidaymaker resides.

09.6.0.2 Package international holidays

– Holidays taking place in other countries.

An additional definition in NACE is relevant in this context:

79.12   Tour operator activities

This includes: arranging and assembling tours that are sold through travel agencies or directly by tour operators. The tours may include any or all of the following:

- Transportation;
- Accommodation;
- Food; and
- Visits to museums, historical or cultural sites, theatrical, musical or sporting events.

12.5.4.2 Price collection (Recommendation 2)

Price collection strategies

For flights and package holidays the shift from purchasing these services from traditional high street travel agents to internet outlets has been both significant and rapid. For some service providers, the internet is now the only way to book flights and package holidays without incurring third party booking fees. As such, the price collection strategy for these services should be centred on internet price collection at head office.

The internet has the clear advantage of offering both a relatively quick and cost-effective way to both sample and collect prices. However, traditional travel agents still exist and in some countries they remain important and in these

cases the sole use of the internet for price collection should be avoided. This is elaborated further in Section 12.5.5.2 — Sampling.

Temporal coverage

In Council Regulation (EC) No 701/2006 of 25 April 2006 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the temporal coverage of price collection in the Harmonised Index of Consumer Prices, Article 3 states that price collection in the HICP (i.e. the temporal coverage):

1. '... *shall take place across at least a one working week period at, or near, the middle of the calendar month to which the index pertains.*

2. *'Where products are known to typically show sharp and irregular price changes within the same month, price collection shall take place over a period of more than one working week.'*

This is of particular relevance to the pricing of flights, the prices of which constantly change, in relation to demand and other factors. Thus Recommendation 2 (Price collection) for airfares states that: *'Price collection should occur over a period of more than one working week if prices are known to be volatile within the month.'*

Price fluctuations are caused by a *yield management* approach to flight pricing introduced by airlines since the deregulation of the airline industry. Yield management is a flexible pricing strategy that anticipates and influences consumer behaviour with the aim of maximising revenue. The differentiation of prices is generally related to various factors of supply of and demand for air transportation services. Airlines provide a scheduled transport service using assets with high fixed costs, they have a fixed capacity and a perishable inventory (once a flight takes off, empty seats can no longer be sold and have no value). While supply is fixed, demand fluctuates depending on the destination, the time of departure and how many tickets have already been sold in advance. As such, customers are willing to pay different prices for essentially the same service and it is therefore possible for airlines to estimate future demand to some extent.

Airlines differentiate prices in various ways. The seats in an aircraft are divided into booking classes that have different prices and a limited number of seats. As a flight fills up, the prices are changed in an attempt to maximise revenue. Travellers pay different prices, and in general the later you wait to book a flight the chances of getting a cheap ticket diminish. Essentially revenue management is *time-slot* management: filling up a plane is not the problem; the issue is to maximise revenue. These factors also apply for flights that form part of package holidays.

Demand for seats at the end of the Friday working day could be high as business travellers want to return home. A consequence of this is that there may be no cheap seats planned for the flight in the knowledge that the flight will fill up anyway.

Specific events like major public holidays, trade fairs, major conferences and international sporting events etc. may also cause an increased demand. Many additional factors complicate this process and the models used by airlines can become very complex.

Given the above factors, Recommendation 2: Price collection, for both flights and package holidays states that *'The prices should be recorded sufficiently in advance of departure to ensure they are representative of consumers' expenditure and behaviour...'* Making a schedule for the price collection of flights rests on a series of assumptions that have to be adapted to the specific situation in each Member State. Input from professionals from within the airline industry could be very useful when setting up such a schedule.

Below are two general considerations which should be kept in mind when developing price collection schedules:

1. Private households in general book flights to go on holiday or to visit relatives. As intercontinental flights are often more expensive, it can be assumed that they would generally be for longer holidays which are booked well in advance. European flights are generally booked closer to the date of departure and are often for just a few days, like a weekend trip.

2. As flights can be booked up to one year in advance it can be assumed that they do not sell out in days and that it is more important to collect prices in several different months prior to the flight rather than days ahead. This also reflects actual consumer behaviour, where most holidays or weekend trips are often booked well in advance of travel.

Timing of entering prices

Currently there are no regulations that specifically refer to the treatment of flights and package holidays in the HICP. However, as both are services, Commission Regulation (EC) No 2601/2000 of 17 November 2000 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards the timing of entering purchaser prices into the Harmonised Index of Consumer Prices applies. Article 2 gives rules for the timing of entering purchaser prices into the HICP. This states that:

> '…Prices for goods shall be entered in the HICP for the month in which they were observed. Prices for services shall be entered in the HICP for the month in which the consumption of the service at the observed prices can commence.'

In the case of flights and package holidays, the consumption of the service, i.e. the start of the flight or the holiday, is in general well after payment has been made.

In Commission Regulation (EC) No 1749/96 of 9 September 1916 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices, Article 2(2) defines a product offer as:

> '… a specified good or service that is offered for purchase at a stated price, in a specific outlet or by a specific provider, under specific terms of supply, and thus defines a unique entity at any one time.'

In practical terms this means collecting in advance the prices to be paid for the consumption of a specified service at a fixed date in the month. Illustrative examples of product offers and price collection schedules are given below.

The same principle applies to rail fares; however, most consumers are likely to book rail fares closer to the planned date of travel than is the case for flights. As such, it may be assumed that most consumers will buy individual tickets for travel within a few weeks of travel. In such cases, the date of purchase should be specified in terms of weeks or days, in advance of travel within the reference month, as in some countries purchasing tickets at the train station on the day of travel is often significantly more expensive.

Taking into account the specific timing and price-determining characteristics of flights, example product offers and an illustrative price collection schedule for flights for both European and intercontinental destinations are given below. The illustrative price collection schedule is also pertinent to package holidays, rail and sea fares. However, national circumstances and charging practices should dictate the design of the price collection. Examples of product descriptions for both flights and package holidays are also given.

The implementation of price collection for flights — an illustrative example

Definition of product offers

Product offer I

- A European weekend trip for one adult person
- Economy ticket — changes for a fee allowed up to 24 hours before departure — on airline X
- One checked-in piece of luggage
- Using a credit card for payment
- From airport B to airport C
- On the second Thursday (in month M) at approx. 6 pm
- With a return on the following Sunday at approx. 8 pm

Product offer II

- A European flight for one adult person
- Economy ticket — no changes allowed — on airline Y
- No checked luggage / hand luggage only
- Using a credit card for payment

- From airport D to airport E

- On the second Wednesday (in month M) at approx. 6 pm

- With a return on the Wednesday of the following week at approx. 8 pm

Product offer III

- An intercontinental flight for two adult persons

- Economy ticket — fully flexible — on airline Z

- One checked-in piece of luggage per passenger

- Using a credit card for payment

- From airport F to airport G

- On the second Friday (in month M) at approx. 8 pm

- With a return two weeks later at approx. 6 am

- Total price for two persons

Product offer I is either known or assumed (on the best information available) to be purchased by consumers typically four months in advance (40 %), two months in advance (40 %), and one month in advance (20 %) of departure.

Product offer II is either known or assumed (on the best information available) to be purchased by consumers typically four months (50 %), and two months (50 %) ahead of departure, and is known to typically show sharp and irregular price changes within the same month. Hence, in the price-collection example given below, two collections are undertaken two months in advance.

Product offer III is either known or assumed (on the best information available) to be purchased by consumers typically nine months (30 %), six months (40 %) and three months (30 %) ahead of departure.

The price collection schedule

The tables below give an example of how a price collection schedule/frame could be organised using the product offers described above. Note that collection can be specified on either a single or on multiple days in order to better capture potentially volatile prices.

Table 12.5.1: Product offer I

Index month: *E.g. September 2016*	Price collection week	Collection day	Time of collection
M-4 — *May*	Second	Mon.-Tue.	9am
M-2 — *July*	Second	Wed.-Thu.	1pm
M-1 — *August*	Second	Fri.	3pm

Table 12.5.2 Product offer II

Index month: *E.g. September 2016*	Price collection week	Collection day	Time of collection
M-4 — *May*	Second	Mon.-Thu.	9am
M-2 — *July*	Second	Fri.	1pm
M-2 — *July*	Third	Mon.-Wed.	3pm

Table 12.5.3 Product offer III

Index month: *E.g. September 2016*	Price collection week	Collection day	Time of collection
M-9 — *January*	Second	Mon.-Thu.	9am
M-6 — *March*	Third	Fri.	1pm
M-3 — *June*	Second	Mon.-Wed.	3pm

Illustrative examples of product offer descriptions for package holidays

Product offer I

- A package holiday for two adults to Destination A, booked with tour operator B

- In hotel C,

- Board type: All / fully inclusive (food and drink)

- Duration: 14 nights

- Flights: departure: around 7 am on the second Saturday of the month from airport X to airport Y

- 15 Kg luggage allowance for each traveller

- Transfers to and from Hotel included

- Paid by credit card

- Total price for two persons

Product offer II

- A package holiday for two adults and two children (under 12 years old), booked with tour operator C

- Destination D

- In hotel E

- Board type: Self-catering

- Duration: 7 nights

- Flights: departure around 10 am on the second Monday of the month from airport X to airport Z

- 15 Kg luggage allowance for each traveller

- Transfers to and from hotel included not included

- Paid by credit card

- Total price for two adults and two children

The above are just two examples of potential product offers. The price collection schedule/frame would be similar to that given for flights above, except that holidays are generally booked further in advance and prices — with the exception of last-minute deals, are generally less volatile, thus a single collection in a specified week per product offer should be generally sufficient.

The schedule given above assumes that prices are collected from internet *by hand* by a price collector imitating a consumer. This is a reliable method to ensure that all additional costs are included in the final price, but it is resource intensive. The use of web-scraping as a method of price collection could be used to increase the frequency of price collection and the number of flights and holiday destinations. However, care must be taken to include all additional costs included in the final price.

Last-minute deals: Flights and package holidays

Last-minute deals — which are more common for holidays than flights — are a marketing approach used by tour operators to sell unsold holidays. There is no agreement on what a last-minute deal actually represents, though a general rule may be a departure date within days or a week (and not months) of booking. The treatment of these very late bookings and one-off exceptional sales is particularly challenging for index compilers. The key part of the recommendation is that these types of last-minute deals should only be included *if significant*. Following general HICP principles, the threshold for inclusion could be if they account for at least one part per thousand of total HICP expenditure. If last-minute deals do not exceed this threshold, then they could be disregarded.

The significance in expenditure terms of these last-minute deals is also likely to vary greatly within the flight and package holiday product groups. For example, weekend getaways can be a popular package in some countries. Related to this, there are purchases where the final service is not known prior to the purchase. Some websites offer reservations for flights or hotels, while providing only partial information of the service. Recommendation 2 for both flights and package holidays states that '… *In addition, the expenditure share of last-minute deals should be investigated and, if significant, included in the index as additional items.'* In many cases these types of late offers are unique or *one-off* (one time only) promotions designed to sell unsold holidays. As such, designing a product-offer description which can be followed throughout the year may not be possible.

One possible solution could be to very loosely define a weekend break package holiday, for example, two nights in a three-star hotel in central Paris for two people, economy flights from airport X included. This product offer could then be priced during the price collection week for any date within the reference month from any provider meeting the specification. Clearly such an approach would need to be tested to ascertain its feasibility.

12.5.4.3 Definition of prices (Recommendation 3)

Recommendation 3 — Price definition, for both flights and package holidays states that:

> *'Prices to be recorded should be the total cost of the service. This is the basic price of the service plus any additional costs necessarily included with the delivery of the service, such as booking fees and fees for using a credit card — where the latter characterises a representative product offer. The item descriptions should clearly specify which additional costs are to be included.'*

While travel agents may charge a booking fee which should be included in the total price, internet purchases, especially for low cost airlines, can attract a number of obligatory charges such as, booking / administration fees, checking-in fees and card-payment fees etc. There are often other options, which are chosen by many consumers which are also charged for e.g. checked luggage, increased flexibility, meals etc. which at the discretion of the index compiler, may or may not be included in product descriptions.

All important price-determining characteristics should be included in the product specification, as both the obligatory booking and card fees along with discretionary services such as checked luggage, together can form a significant part of the total price — particularly for low cost airlines.

The aim for the index compiler is to construct product-offer descriptions that are representative/characteristic of a typical consumers' booking. Alternatively, all additional charges (whether compulsory or optional) may be comprehensively incorporated into the index by weighting these charges in accordance with their actual expenditure shares, if the data are available.

How far in advance a flight is booked can directly affect the prices consumers pay which directly influences consumers' behaviour, and therefore forms an integral part of the product-offer description. This issue is elaborated in the following sections.

In practical terms this requires very tight product descriptions, including all the characteristics, which define the cost of the flight. It is particularly important to differentiate between flexible (the option of changing a flight and/or claim a refund when the flight is not taken) and non-flexible fares, as this is a key price-determining characteristic of flights.

In general, insurance should be recorded as such in ECOICOP 12.5.4.2 — Travel Insurance. But, if the insurance in question is obligatory and exclusively connected to the individual purchase of the travel in question and the cost of the insurance cannot be separated from the price of the flight, then it should be part of the total cost of the flight. If such insurance is not obligatory, then it should not be included in the cost of the flight. The cost should be covered in the index for travel insurance.

In some countries, national regulatory authorities run schemes, which protect consumers should a tour operator or airline cease trading either before or during travel. For example, in the UK, under Civil Aviation Regulations, ATOL certificates (Air Travel Organiser's Licensing) are issued, which indemnify consumers. This protection is paid for by the UK's Air Travel Trust, which is financed by the travel industry through levies on each passenger. Such levies are generally obligatory and as such should be included in the total cost of the flight or holiday. Again national practices will vary, and as such the treatment of such schemes will depend on national circumstances.

12.5.5 Practical implementation

12.5.5.1 Data sources

The internet has opened many opportunities to consumers to research and book travel from the comfort of their homes or even on their mobile phones. With this almost unlimited choice come both opportunities and potential problems for index compilers, in terms of choosing representative product offers, estimating weights and pricing selected flights and holidays. In addition to online retailers, traditional high street travel agents may still account for a significant market share of travel and package holiday bookings in some countries and also need to be included.

The main data sources that could be useful for both sampling and estimating weights are:

- National regulatory/civil aviation authorities
- Airports
- Airlines/tour operators
- Tourism statistics
- Household budget surveys
- Trade bodies
- Market research companies
- Bespoke travel surveys

While, in theory, a well-constructed household budget survey should provide accurate expenditure weights for travel/holiday expenditure that starts from the country of residence, a revised household budget survey or other data sources are needed in order to separate out travel and accommodation services commencing abroad.

Uniquely, however, the tight security involved in undertaking international air travel has resulted in the collection of data for every journey taken. At the very least airports should be able to provide the numbers of passengers that have flown to each destination they serve (and some airports publish this data at least in aggregate form, on their websites). Airlines should also be able to provide information on the number of passengers they have carried by destination too. Together or individually, these potential data sources should allow index compliers to select representative destinations and provide an input for estimation of detailed weights. This is particularly true for hub airports, and for the smaller Member States, where only a single airport exists. It should be noted that using the number of aircraft movements as a proxy of the above is a sub-optimal approach and should be avoided. If Member States approach airports directly, then it is likely that the detailed information required could be obtained which would assist in identifying representative destinations etc.

An alternative source for selecting representative destinations for flights, are national civil aviation authorities, which often collect detailed data covering the entire country. Such databases may be a good place to start for larger Member States which have a number of international or hub airports. For example, in the UK the Civil Aviation Authority publishes ([133]) detailed information on the number of passengers travelling on each scheduled flight route. It is likely that such data sources exist in other Member States too.

For package holidays, in addition to tour operators themselves, Member States collect a lot of data on tourism, which are collated by Eurostat and can help in selecting destinations for package holidays etc. There are also market research companies and tourism trade organisations, which collect data as well. Additionally, as some regional airports largely serve the package holiday market, regional airports may also be able to provide information on the most visited tourist destinations.

In terms of sampling destinations for both flights and package holidays, the data that are most likely to be available is the number of passenger flights taken. This is sub-optimal as these data may not exclude business travellers and will normally not reflect the fact that the cost of both flying and package holidays varies considerably between destinations. Nonetheless, using such data is far superior to using a completely subjective approach.

([133]) http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

For last-minute deals, expenditure data on the significance of these flights and package holidays can be gathered either through the household budget survey or, more likely, through an ad hoc survey of travel service providers.

12.5.5.2 Sampling

The above data sources may allow Member States to perform some type of probability sampling rather than purposive sampling (see Chapter 4).

- In terms of sampling, it is sensible to distinguish between domestic, intercontinental, European and seasonal holiday destinations to ensure that the range of flights and package holidays purchased by households is covered. For the purpose of ECOICOP, the only distinction that needs to be made is between domestic and international flights and holidays. Of course the former in terms of flights, will only apply to a few of the larger Member States. However, as intercontinental and intra-European flights and package holidays can attract differing levels of tax in some countries, it may make sense to use a finer regional stratification in index compilation than the ECOICOP minimum.

- The role and importance of domestic flights for private households should be looked into at a national level: these flights could refer to domestic holidays but could just as well refer to connecting flights for intercontinental holidays. If the latter is the case it could be more important to price the domestic flight as part of a longer intercontinental journey. This also applies for smaller countries where consumers purchase flights to one of the major European hubs in order to travel to intercontinental destinations.

- In some countries, seasonal holiday flights to such destinations as the Greek and Balearic Islands are also representative and should be included in the sample if expenditure on these types of flights is significant. These types of flights have grown in importance in recent years as many consumers now choose to book travel and accommodation separately so as to personalise their holidays. The growth of low cost carriers, which now serve these seasonal destinations, has also added to their significance.

- In general, index compilers should restrict product offers to economy class tickets (unless the pricing of business class tickets can be justified), as this is the most frequent class of travel for both flights and package holidays. The distinction between business and private household customers is difficult to make. Being selective in choosing destinations could be an easier way to exclude business passengers. For example: the flight on its own from Amsterdam to Frankfurt makes hardly any sense for a private Dutch consumer. However, some caution must be exercised, as flights to destinations such as New York and London, while clearly serving business travellers, are also popular tourist destinations. Looking at the number of business class passengers on various flights is not particularly helpful in identifying which flights are mostly business-oriented. This is because not all travellers who fly business or first class are necessarily travelling on business, and not all passengers who fly economy are tourists, as many companies will only pay for economy tickets for employees travelling on business — particularly on short-haul flights.

- If there are multiple flights on a day, it can be assumed that a typical private household will opt for the cheapest possibility while business passengers generally favour early morning and late afternoon flights.

- The sample for both flights and package holidays should reflect national circumstances and preferences. Package holidays also include holidays where the inclusive travel is by coach or train (e.g. European coach tours and Eurostar holidays to Euro Disney etc.). The sample should also include regional as well as national hub airports if their market share is significant. For smaller Member States, where direct intercontinental flights may not be available, booked fares should be sampled according to the most usual flight connections, e.g. Ljubljana to New York via Frankfurt etc.

- While the internet is becoming the norm for purchasing flights and package holidays in many Member States, it may be less representative at this point in time in other countries. In all countries, traditional high street travel agents are still offering their services. As such, these should be covered in addition to internet purchases, in proportion to their relative market share, the sole use of the internet for both sampling and price collection should be avoided as the two outlet-types offer differing levels of service. As such, both the sample and price collection should include traditional high street travel agents. This is important, as traditional travel agents can often get competitive rates particularly for hotels.

In effect, the internet and traditional outlets represent the two major outlet-types which should be sampled. Recommendation 1 Coverage, for both flights and package holidays states that:

> '*The expenditure (weight) and the price for airfares* [and package holidays] *booked and paid for in a high street travel agent should be entered in the HICP of the Member State where the purchase is made. The expenditure (weight) and the price for airfares* [and package holidays] *booked on internet should be entered in the HICP of the Member State from which the flight first departs.*'

In most Member States, this distinction is not relevant as travel starts within the country of residence. However, this distinction is relevant where it is common to cross a border to take a flight. For example, a Luxembourg consumer books a package holiday to the Maldives involving a direct flight from Frankfurt. If the cost of the holiday is booked in a high street travel agent, then the expenditure and price belong to the Luxembourg HICP. If the holiday is booked via the internet, then both the expenditure and price belong to the German HICP.

In addition to the websites of airlines and tour operators, prices can also be collected from travel comparison sites such as Opodo.com and Trip Advisor etc. and if important, these websites should be included. As with all websites care should be taken to ensure all elements (checked baggage, booking fees etc.) of the product description are included in the price.

12.5.5.3 Quality adjustment

The most important aspect of quality (as broadly defined by class of travel) is the flexibility to change flights, which is also linked to the refundability of flights not taken. As well as the need to specify flexibility in the product offer descriptions, the degree of flexibility also needs to be taken into account in replacement situations.

Similar quality issues, which are sometimes difficult to capture, are also present in package holidays. The potential for quality changes to occur underlines the need for accurate and comprehensive specification of product offers for both flights and package holidays. While it is unlikely that a specific holiday package will disappear during a single season, should this occur, then a similar holiday in terms of destination, time of flight, and class of accommodation should be selected from the same holiday resort (where possible).

Flight schedules are changed relatively rarely and such time changes are normally constrained to the same part of the day (morning, afternoon and evening). The departure, but especially the arrival time, is an important quality aspect. However, changes in departure/arrival times are impossible to quantify (without full data) and the flights should be considered equivalent. If there are multiple flights on a day, then the replacement should be the flight closest to the replaced flight.

Changes in the departure and arrival time of a flight are a quality difference that is not equally important to all consumers. Because it is difficult to quantify in a meaningful manner, if the airline and destination remain the same, such changes should be ignored.

Another quality change can occur when a flight booked, for example, on the website of Austrian Airways, is operated by a partner airline for example Luxair. This practice is known as *code sharing* and is a common practice in a market dominated by airline alliances such as One World and Star Alliance etc. In these cases a direct comparison should be made.

Many other factors can play a role in the quality of a flight/package holiday and may change over time like having a free-meal change into a paid snack, the ease of checking in, the time needed to pass through security. All such factors are difficult to quantify and should be ignored.

12.5.5.4 Seasonal availability of flights and package holidays

Flights and package holidays both demonstrate seasonality in terms of their availability and in consumer demand. While Commission Regulation (EC) No 330/2009 of 22 April 2009 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of seasonal products in the Harmonised Index of Consumer Prices does not mention flights or package holidays, Article 3(2) states:

> '*Where appropriate the minimum standards for seasonal products shall serve as guidance also concerning seasonal products within COICOP/HICP classes and groups other than those listed in the first paragraph*' [of Article 3].

The Regulation only relates to strongly seasonal products i.e. products that are not available for purchase during certain months, or the numbers purchased are zero or negligible, and the periods of non-availability have some typical annual cyclical pattern. For flights/package holiday (destinations) there are three situations:

1. Destinations that are not seasonal, e.g. flights between Amsterdam and London

2. Destinations that are weakly seasonal (flights are available throughout the year but the number of flights/capacity of planes vary)

3. Destinations that are strongly seasonal (for example summer flights to the Greek and Balearic Islands or ski holidays in the Alps during the winter).

Section 7.1 discusses in detail the treatment of seasonal products. In the following paragraphs, guidance is given on how to apply seasonality for flights and package holidays in relation to Regulation (EU) No 330/2009.

Compared to other strongly seasonal products, such as clothing and fruit and vegetables, etc. seasonal flights (typically to summer/winter holiday destinations) are either available or not available in given months, and the prices of the flights offered are typical for the month in question. There are no atypical months. Consequently, in these cases, if a fixed weights method is used, it would make sense to impute prices (price changes) from either all available flights (all-seasonal estimation) or all in-season flights (counter-seasonal estimation) from the *first* month of unavailability. The last available price is typical for that month and should form the basis for the imputation of the first out-of-season month. This is in contrast to using some type of *typical in-season price* to impute a price for the first month of unavailability and then impute prices from available flights from the second month. This is required by Regulation No 330/2009 for those product groups whose last observed prices are atypical due to either restricted availability (e.g. food products), or where the last observed prices are largely sales prices (e.g. clothing). The use of a typical in-season price is required for these products so as not to bias the imputations in the following out-of-season months (see Section 7.1).

However, dependent on the IT environment existing in each Member State, it may not be possible to impute prices from the first month of unavailability as described above, and some type of typical in-season price is required. In such cases the last observed in-season price should be used, average in-season prices or last typical in-season price etc. should not be used as these could potentially bias imputations in the following out-of-season months.

As with flights, seasonality in package holidays is complex. While some holiday destinations and city breaks are genuinely all year destinations, which present few problems for the index compiler, many holiday destinations have distinct seasons in which tour operators offer package holidays for sale. As with flights, availability is black or white, prices are available or they are not, and the prices offered are not *atypical*. As such, the use of a typical in-season price for the first month of unavailability appears questionable. For these cases, imputation from the first month of unavailability should be preferred where a fixed weights method is used and where the IT environment allows this. The overlapping seasonality of package holiday destinations, and the availability of all year round package holiday destinations, suggests the use of the *all-seasonal* approach to the imputing of out-of-season package holiday prices (see Section 7.1). This would involve using the prices of all available package holidays for imputation.

Where a class-confined seasonal weights method is used, the definition of the in-season and out of season months is clearly defined as the flights/package holidays either are or are not available. When fights or package holidays are no longer available, their weights are set to zero. The estimation of in-season weights under this approach is described in Section 7.1. As with the fixed weights approach, the overlapping seasonality of holiday destinations should allow for the collection of representative product offers in every month.

Although some holidays are only available in the summer months, their prices are often advertised during Q4 of the previous year, which will allow for their inclusion in the sample.

Whichever approach is followed, it is recommended that all year round city breaks to destinations such as London, Rome and Paris etc. are included in the sample. This will allow the imputation of missing prices throughout the year, especially if the range of package holiday destinations during the low season (typically the winter months) is limited.

An additional seasonal issue, which can affect both flights and package holidays, is the timing of some public holidays — notably Easter, Christmas and New Year and in some countries the May public holidays. Flights and holidays taken at these times can be atypically expensive due to higher demand. However, these are actual seasonal price effects experienced by consumers. As such, the pre-specified price collection schedules should be observed and not amended, as this would introduce a bias in the index.

For flights to certain destinations, one-off international conferences or events (concerts, major sporting tournaments etc.) can lead to increased demand and hence atypical prices. In general, the price schedule should be observed and not altered unless the observed price is very extreme. As the sample of flights should be sufficiently large to represent consumer's behaviour, the occasional atypical price should not disturb the overall flights index. In this context it should be remembered that the price to be followed is for a product offer sold under *specified conditions*, which includes the day of travel, which is integral to the product specification, and not the flight a particular consumer may choose when faced with such one-off situations.

12.6 Telecommunication services

12.6.1 Introduction

The telecommunications industry is very dynamic; new products are continuously being developed and some services, which were previously being offered to consumers separately e.g. internet provision, are now being bundled into new products such as phone, internet and TV packages. Additionally, the way in which consumers are charged for these services also varies considerably. For example, in some Member States consumers typically purchase a mobile phone separately from a call plan, in other Member States, the phone is included in the monthly price either for free or at a greatly reduced price. Additionally, the way services are charged for may evolve over time. Reflecting these differences, the most appropriate method(s) for measuring telecommunications will vary from one Member State to another.

Recommendations have been produced to provide guidance on the methodological treatment of these services in the HICP in order to support the legal requirements of the HICP in terms of comparability, reliability and relevance.

Following the recommendations, the explanatory text provides more background to the recommendations themselves and explains the meaning of several terms used. The recommendations cover all types of telecommunication services including fixed line, and mobile telecommunication services, along with internet provision and bundled phone, internet and TV packages. Given the particular complexities of the mobile phone market, particular attention is given to measuring these services.

In this dynamic sector it is not only the method used to measure price change which is critical, but it is the way in which the method is applied by each Member State which is perhaps more important. These recommendations recognise that any single approach may not be suitable or generally applicable for all market sectors (i.e. fixed line and mobile telecoms) or all telecommunication services, which are offered today in any particular Member State (e.g. phone, internet and TV packages etc.). A mix of methods may be required depending on the particular circumstances of each Member State.

12.6.2 Recommendations

Recommendation 1: Coverage

The price index for telecommunication services (ECOICOP 08.3.0) should cover wired and wireless telephone services, internet services and bundled telecom services that include television.

Recommendation 2: Weights

The weights for the ECOICOP 08.3.0 sub-classes should be reviewed annually and, if necessary, updated. The market for telecommunication services may be stratified and weighted below the sub-class level if needed, depending on national circumstances.

Obtaining information on weights is essential for the compilation of the indices. National regulatory bodies and telecom providers are recommended sources of information.

Recommendation 3: Sampling

The sample should include all significant ECOICOP sub-classes. The sampling frame and sample (could be in terms of consumer profiles) should be reviewed annually at the minimum to keep the sample representative.

Because the telecommunication services market can be very dynamic, it is recommended to review and update the sample more frequently than once a year.

Recommendation 4: Replacing tariffs

If binding contracts are used, new tariffs should be phased in, preferably using migration rates. If non-binding contracts are used, new tariffs may replace existing tariffs as they become available, but only if supported by evidence that consumers rapidly migrate.

If no empirically supported migration rates are available, some reasonable model for rational consumer behaviour should be used.

New tariffs may only be linked to show no price change, if there is a justification to do so.

Recommendation 5: Index compilation methods

There are four methods to compile the sub-indices for telecommunication: the tariff, consumer profile, unit value and actual usage approach. The methods can be rated as A, B or C depending on their actual implementation. This is highly dependent on the source and frequency of updating weights. The first two methods are the most commonly used ones.

The tariff method takes prices from the tariff list in both periods as a matched pair. The method is rated as a B method in a stable market, such as fixed telecommunication services. In dynamic markets (such as wireless telecommunication services) the method is rated as a C method.

The pre-defined consumer profiles approach uses pre-defined consumer profiles and is an A method if the profile is frequently checked against actual use. If the profiles are based on some other source like in-house judgements by the Member State, it will be a B method. If there is no justification for the profile, then this method is rated as a C method.

The unit value approach assumes that the content of a tariff-based service is well-defined and homogeneous and a unit value is used to track price development. If the service is indeed homogeneous, then this is a B method for both stable and dynamic markets; otherwise it should be rated as a C method.

The actual usage method uses all or nearly all transaction data to create one profile for which prices are collected. If it applies to all consumer transactions and is regularly updated it may be considered an A method. If the profile is based on some other source like in-house judgements by the Member State, it will be a B method. If there is no justification for the profile, then this method is rated as a C method.

The methods may be used in combination.

Recommendation 6: Treatment of bundles

Pure bundles are bundles of services that are only available as a bundle and not sold separately. The expenditure should be allocated to the ECOICOP sub-class according to the purpose of the main component.

There are two exceptions. Mobile call plans often include mobile internet, and these bundles are to be included in wireless telephone services, regardless of the importance or weight of the two components. This is also the case with call plans that include the cost of a mobile telephone; these are also to be included in wireless telephone services.

Mixed bundles are products which are sold both in bundles and, separately, as stand-alone products. The expenditure on stand-alone products belongs in their respective ECOICOP sub-classes.

The expenditure of mixed bundles should be dealt with according to the Recommendation on the Treatment of Bundles (see Section 7.6): '*unless the constituent components can be weighed and itemised easily, the bundle should be allocated to the ECOICOP sub-class according to the purpose of the main component.*'

Mixed bundles that include combinations of telephony, internet and television are allocated to COICOP 08.3.0.4 Bundled telecommunication services.

Recommendation 7: Discounts

Discounts should be taken into account according to the HICP rules and recommendations.

However, without information on actual usage it may be difficult to estimate the necessary adjustments. It is therefore recommended to focus on discounts that have either a direct effect on the price and/or have a direct effect on the main components of the service. Other discounts should only be included if they have an empirically justified significant impact.

Recommendation 8: Quality changes

Horizontal quality changes are changes that apply to all customers or affect the entire network. Often these changes cannot be taken into account on practical grounds, in which case the tariffs may be linked to show no change.

Vertical quality changes are changes in the characteristics between a replaced and a replacement tariff package. The following is recommended:

- For the tariff approach, such changes should be adjusted for;

- For the other approaches vertical quality changes are implicitly included in the method.

12.6.3 Telecommunication services and the HICP legal framework

Traditionally, telecommunication services have been treated in the HICP following the definitions and procedures laid down in Commission Regulation (EC) No 2646/98 of 9 December 1998 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of tariffs in the Harmonised Index of Consumer Prices. Article 5 — Procedure, which defines the pricing concept, is particularly relevant:

> 'HICP sub-indices involving tariff prices shall be calculated using a formula which is consistent with the Laspeyres-type formula used for other sub-indices. They should reflect the price change on the basis of the changed expenditure of maintaining that consumption pattern chosen by households prior to the given change in the tariff.'

In other words, it is the change in expenditure of maintaining the consumption pattern of households in the price/weight reference period which is to be followed, and not the consumption pattern in the current period, which may have changed due to changes in the tariff structure. By maintaining the price/weight reference period consumption pattern, a measure of *pure price change*, which is free from changes in the structure or quality of tariffs, and changes in consumer behaviour, can be obtained.

Complying with Article 5 as described above, is central in evaluating the possible approaches to measuring the array of telecommunication services on offer. Compliance with this Regulation is also essential for ensuring that the comparability requirement of the HICP is maintained — as defined in Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, Article 4. Section 7.4 explains in detail the approaches that can be used to measure tariff prices.

12.6.4 Definitions

Call plans: are packages or bundles of services e.g. a certain number of call minutes, text messages and internet usage per month for a certain price.

Binding contracts: are contracts in which consumers are legally bound to a provider for a pre-defined period of time, for example 12 to 24 months, during which changes are generally not allowed.

Non-binding contracts: are contracts where consumers are free to change their tariff or end their contract with no financial penalty. Generally these contracts are short term (monthly) as is the case for many pay-as-you-go call plans.

Migration rates: in between annual resamplings, they describe the transition of consumers from one tariff to another (from the same provider) in terms of what proportion of consumers change and at what pace.

Stable markets: refer to services which have broadly remained unchanged or have evolved relatively slowly. Examples are fixed landline telecommunication services.

Dynamic markets: refer to those services and products that change rapidly. Examples include mobile telecommunications and bundled phone, internet and TV packages.

12.6.5 Index compilation methods (Recommendation 5)

Introduction

The computation and publication of a telecommunication services price index has to find a trade-off between publishing at a very detailed level to satisfy user needs and an approach that should enable maximum flexibility, e.g. the bundling of services which is commonplace in this sector. The fixed basket approach with weights at a very detailed level appears to fail in such situations, as it is not able to capture the dynamics of the telecommunications market and the complexity of pricing schemes within a rapidly developing sector. The large number and the continuous change of price-determining characteristics caused by the rapid changes and growth occurring in this market and driven by continued technological development in this sector requires an approach to index compilation which affords maximum flexibility in order to capture actual price trends.

There are four methods/approaches to compile the sub-indices for telecommunication services: the tariff (or matched pairs); consumer profile; unit value; and actual usage (sample of bills) approaches. Section 7.4 discusses each of these approaches in more detail. One or several of the methods may be used in combination to measure the overall telecommunication services index. The tariff and consumer-profile methods are, however, the most commonly used methods by Member States.

According to the scheme in Commission Regulation (EC) No 1749/96 of 9 September 1996 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices Article 5(1), the methods can be rated as A, B or C methods, depending on their actual implementation. The A methods are the preferred methods, the B methods are acceptable, and C methods should, preferably, not be used (see Section 6.4.2).

General evaluation of methods under stable and dynamic market conditions

Concerning the evaluation of each pricing method, there is no clear assignment of the methods to the A, B and C rating scheme; the assignment depends on the flexibility with which the method is *actually applied* in a Member State and especially the source of weights (and profiles where applicable) and the frequency of their updating. If samples are kept constant for a long time or are only updated within an annual resampling procedure, then each method can easily be rated as a C method. To be rated as an A method, the use of additional information about market shares and substitution behaviour (migration rates) is necessary. Therefore only a general assessment can be made.

Table 12.6.1 gives a generalised evaluation of the approaches in the context of their use under stable and dynamic market conditions

Table 12.6.1: General evaluation of pricing methods in the telecommunications sector

Approach	Weights information	Stable markets	Dynamic markets
Tariff		B	C
Pre-defined consumer profiles			
	First-hand	A	A
	Other sources	B	B
	None	C	C
Unit Value			
• homogenous categories		B	B
• non-homogenous categories		C	C
Actual usage			
	First-hand	A	A
	Other sources	B	B
	None	C	C

In the following paragraphs each of the methods will be described and rated in terms of their applicability to measuring telecommunication services.

Index compilation methods

The tariff or matched pairs method

Tariffs are a pre-determined set of specified costs for a specific set of services. Under this approach, prices are taken from the full tariff list (package) or an element of the tariff structure in both periods being compared as a matched pair. In effect, each tariff package is treated as a single product (i.e. a product specification). The most popular/representative tariff packages are selected in the price reference period (December of each year) and they are followed as long as some customers subscribe to them. When a new comparable tariff package is introduced on to the market to replace a discontinued tariff package, the new one is linked into the sample and prices can be compared directly. This method is particularly suitable for services based on flat rates instead of pay-per-use plans or charges for actual usage. This is because of the difficulty in identifying typical usage patterns and the estimation of the weights of each tariff element. When tariff prices are compared directly in a replacement situation, this improves the statistical quality of the resulting price developments. Changes from old to new tariffs are thus reflected in the index. Such a methodology can work well in situations where old and new tariffs do not co-exist on the market and the customers are forced to adopt the new tariff plans as soon as they are introduced. Where old and new tariffs co-exist on the market — which can be the case where binding contracts exist —, then the new tariffs should be phased in, preferably with the use of migration rates.

Table 2 gives a small and simplified numerical example of the tariff method over two periods ($t = 1$ and $t = 2$). In this scenario, new and old tariff packages do not co-exist on the market in any period. There are two providers A and B, and three tariff packages (i.e. product offers) in each period. Provider A offers two tariff packages (p = 1 and p = 2) while provider B offers only one tariff package (p = 3). Each tariff package includes three distinct tariff items/elements: 1) Basic fee; 2) Domestic call; and 3) International call.

For provider A, tariff package 2 exists only in period 1 and it is replaced by tariff package 4 in period 2. The relative turnover or expenditures for the three elementary aggregates are the weights.

In period 1, a price index for each elementary aggregate (tariff element) is computed. Then following a Laspeyres approach, a weighted price index per provider is calculated with the relative shares of the tariff packages from the weight reference period as weights, and the total index for each item is computed for each period by weighting together each provider's price indexes with the provider's respective weights from the base period (see Chapter 8 — Index calculation).

In Table 12.6.2 the price indices for the providers were computed with the arithmetic mean, and the aggregation for a common price index is undertaken with provider weights (provider A 66 %, provider B 34 %). The weights of the tariff packages and those of the providers are kept constant over time in accordance with the Tariffs Regulation. Then the price indices for the single items are aggregated by a weighted average with the turnover shares as weights. The resulting index is 100.78 in the second period.

Table 12.6.2: The tariff method — fixed/wired telecommunication services

Period		1				2			
Provider		A	A	B	Total	A	A	B	Total
Tariff		1	2	3		1	4	3	
Item	*Weights*	36.4 %	29.3 %	34.3 %	100.0 %	36.4 %	29.3 %	34.3 %	100.0 %
Basic fee	73.7 %	15.00	10.00	13.00		15.00	11.00	13.00	
Domestic call	16.2 %	0.25	0.30	0.30		0.25	0.25	0.30	
International call	10.1 %	0.10	0.15	0.10		0.10	0.12	0.10	
Index values for each tariff package									
Basic fee		100.00	100.00	100.00		100.00	110.00	100.00	
Domestic call		100.00	100.00	100.00		100.00	83.33	100.00	
International call		100.00	100.00	100.00		100.00	80.00	100.00	
Provider, items and total aggregation									
Provider weights		65.7 %		34.3 %	100.0 %	65.7 %		34.3 %	100.0 %
Basic fee	73.7 %	100.00		100.00	100.00	104.46		100.00	102.93
Domestic call	16.2 %	100.00		100.00	100.00	92.56		100.00	95.12
International call	10.1 %	100.00		100.00	100.00	91.08		100.00	94.14
Total	100.0 %				**100.00**				**100.78**

Evaluation and recommended use of this method: This method is rated as a B method in stable markets, if justified (i.e. evidence-based) weights and migration rates are used. In dynamic markets, where tariffs, tariff elements and tariff structures change frequently, and in the absence of justified weights and migration rates, the method is rated as a C method.

The consumer profiles method

Consumer profiles are defined independently of providers' tariff structures and resemble typical or average consumer usage patterns. Under this approach, the measurement target is the minimum cost of a pre-defined and fixed pattern of use. It is the price of a fixed volume of use from a specified provider which is followed and not the change in price of a specific tariff (product offer), which is the approach normally used for most goods and services in the HICP.

Key points to note:

- The specifications of the profiles should be based as far as possible on data supplied from either the service providers or the regulator, in order that the specified profiles are as representative as possible of consumer behaviour.

- As there is no *one* typical pattern of use, it is necessary to develop a number of profiles which represent different volumes of use. A common approach is to develop at least three profiles covering high, medium and low-use users. The actual number of profiles, however, should be guided by the nature of the market in each Member State.

- The profiles should remain fixed between annual resamplings, regardless of what new tariffs appear on the market. Both the selected profiles and their associated weights should be reviewed and updated annually as required to reflect the dynamics of the market. However, the sample of tariffs priced in the price reference period should be reviewed in between annual resamplings to ensure their continued representativity (see Recommendation 4).

- In the telecommunication sector, binding contracts are typical. As such, new tariffs which appear in between annual resamplings should not automatically replace existing tariffs in the sample. They should be phased in using migration rates which are preferably based on data supplied by service providers. Where no evidence-based migration rates are available, a rational consumer approach should be used (see the explanation to Recommendation 4 — Replacing tariffs, below).

- Replacement tariffs should be selected from the same provider as the replaced tariff. In-year replacements between providers should not be undertaken, unless a sampled provider no longer provides the specified service.

- New service providers that emerge on the market should be included in the sample in accordance with their market share (if significant) in the December following their emergence.

- Each month, for each specified profile, the prices of the tariff which meets the minimum usage requirements of the specified profile is priced from each of the sampled providers.

The weights for individual profiles and providers may be estimated using sales information to determine the relative importance of the different tariffs.

Following a Laspeyres approach the overall index is then derived by weighting together the average cost changes for these user profiles according to the relative importance of each category of consumers. In practice, however, in order to be reliable for all the elements of the tariff, the segmentation of the users may require a large volume of information and detailed specification on the usage patterns. There are many advantages to the consumer profile method. If the method is well established and defined, the identification of appropriate packages from each supplier and for each user profile is easier. The method is also flexible enough to react to current developments in a changing market. Where the process of price collection is supported by the application of migration rates between existing and new tariffs, the results will be even better.

A fully annotated example of the method is presented in Annex 12.6.

In Table 12.6.3 below a simpler presentation of the method is given. In this example, two profiles are defined, a low and a high user. In period 1 for each profile the *cost for the specified pattern of use* is estimated. The same is done for period 2 (top section of the table). In both periods, the tariffs which yield the minimum price i.e. lowest bill (for each profile and provider) are then selected (the middle section of the table). From these values the aggregates with fixed profile and provider weights are calculated (bottom section of the table). In this example, tariffs A2 and A4, which were selected in period 1, were replaced by tariff A4 in period 2, as this tariff yields a lower bill for the specified use profiles. It is assumed that the profiles are evenly distributed among the population and therefore the average bills from the weight reference period are used for the profile weights. The example also assumes that it is easy to move between tariffs within the same provider, which is not always the case.

Table 12.6.3: The consumer profile method — mobile call plans

Period			1				2			
Provider			A	A	B	Total	A	A	B	Total
Profiles			1	2	3		1	4	3	
Item	Low	High								
Basic fee			15.00	10.00	13.00		15.00	11.00	13.00	
Domestic call	20	60	0.25	0.30	0.30		0.25	0.25	0.30	
SMS	10	180	0.10	0.15	0.10		0.10	0.12	0.10	
Profile sum low			21.00	17.50	20.00		21.00	17.20	20.00	
Profile sum high			48.00	55.00	49.00		48.00	47.60	49.00	
Minimum selection										
Provider			A		B		A		B	
Low			17.50 (A2)		20.00 (B3)		17.20 (A4)		20.00 (B3)	
High			48.00 (A1)		49.00 (B3)		47.60 (A4)		49.00 (B3)	
Provider, items and total aggregation										
Provider weights			65.7 %		34.3 %	100.0 %	65.7 %		34.3 %	100.0 %
	Weight		A		B		A		B	
Low	19.50	27.79 %	100.00		100.00	100.00	98.29		100.00	98.87
High	50.67	72.21 %	100.00		100.00	100.00	99.17		100.00	99.45
Total	70.17	100.00 %				100.00				99.29

Evaluation and recommended use of this method: The pre-defined consumer profiles approach is an A method if the profile is based on, and frequently checked against, actual use derived from data supplied by providers or regulators. Checking should take place with each annual update of the sample in December of each year. If the profiles are based on some other source such as in-house judgements at the Member State, this approach is considered to be a B method. If there is no justification for the profile, then this approach is rated as a C method. This method is recommended for both dynamic markets and markets where pure bundles are commonplace.

The Unit Value Method

The unit value method relies on the assumption that the content of a tariff-based service is well-defined and homogeneous. A unit value is then used to track price developments. It is applicable where service providers have a clear structure of usage charges, as is found in some fixed telecommunication services. The method is less applicable to mobile telecommunications services if the costs of individual tariff elements are not identifiable. The revenue of a specified service is divided by the amount of time the service is consumed. The resultant unit value is multiplied by its weight in the weight reference period and aggregated within the tariff structure. An advantage of this approach is that the emergence of new tariffs does not affect the method. Another advantage is that by calculating unit values using revenue data, the potential discounts are included in the index calculation, since they are already incorporated in the reported revenue data of the responding enterprise. A drawback to this approach is that the use of unit values will not guarantee a measure of pure price change. Rather, it will provide only an approximation, as the use of each service may vary from one month to the next.

In order to implement the unit value method, the service categories priced should be as precise and homogenous as possible, which may not always be the case. Service categories can be defined for example by:

- Call price by distance

- Call price by time slot

- Call price by length of the calls

- Cost of line rental

Cooperation with the national telecommunications authority and service providers is important if the benefits of the unit value method are to be fully realised. Service providers will have information about the revenue of a specific service and the amount sold. If this method is applied to the mobile market, which is generally more complex than the fixed line market, information on more homogeneous sub-groups is needed for separating fixed and variable charges in order to re-price sub-services from one period to another period. Otherwise the pure price change cannot be reliably estimated. In practice, it might prove difficult to apply this method in a timely fashion, as the required data from the company may not be available.

While the unit value method is different from the other pricing methods, the change in the use of the existing services is not considered to be such a problem (unless such changes vary considerable from one month to the next), since the service product groups in the family tree will retain the migration of consumers between old and new packages. A potential disadvantage of the unit value pricing approach is through the potential creation of non-homogeneous or heterogeneous product groups covering both price changes and structural changes together.

Table 12.6.4 gives an example for the unit value method with the index calculated following a Laspeyres approach. Instead of using the prices for the tariff elements, unit values are used. This approach takes into account the migration rates between tariff plans within a provider and of discounts. The main difference is that in the traditional tariff approach, where the relative shares of the different tariff plans is kept constant over time, the use of unit values within a provider takes account of changes in the relative shares of different tariff elements from one month to another. This difference can be problematic if the changes reflect both price changes and structural changes together.

Table 12.6.4: The unit value method in the case of fixed line telephone charges

Period		1			2		
Provider		A	B		A	B	
Item	Weights			Total			Total
Turnover							
Basic fee	73.7 %	1 650 000	884 000		369 817	190 512	
Domestic call	16.2 %	363 000	204 000		142 571	117 513	
International call	10.1 %	247 500	102 000		107 468	50 329	
Quantities							
Basic fee		132 000	68 000		28 447	14 655	
Domestic call		1 320 000	680 000		760 380	391 711	
International call		1 980 000	1 020 000		976 980	503 293	
Unit values							
Basic fee		12.50	13.00		13.00	13.00	
Domestic call		0.28	0.30		0.19	0.30	
International call		0.13	0.10		0.11	0.10	
Index values							
Provider weights		65.7 %	34.3 %	100.0 %	65.7 %	34.3 %	100.0 %
Basic fee	73.7 %	100.00	100.00	100.00	104.00	100.00	102.63
Domestic call	16.2 %	100.00	100.00	100.00	68.18	100.00	79.11
International call	10.1 %	100.00	100.00	100.00	88.00	100.00	92.12
Total	100.0 %			100.00			97.76

Evaluation and recommended use of this method: The unit value approach assumes that the content of a tariff-based service is well-defined and homogeneous. If the service is indeed homogeneous, then this is a B method for both stable and dynamic markets; otherwise it should be rated as a C method.

Actual usage/sample of bills method

The actual usage or sample of bills method, which is sometimes also referred to as the comprehensive basket method, uses all or almost all transactions in a certain market segment (e.g. mobile telephone call plans etc.) to construct a single profile, which represents the average pattern of use for all consumers. In between annual reviews, the consumption pattern is kept constant; however, the weights used for aggregating the various tariff plans offered by a provider, and the relative market shares of each provider are flexible i.e. can change. With this approach, changes to the features of tariff packages as well as the migration of consumers from one provider to another, are reflected in the index. However, differences in substitution rates between providers in between annual resampling results in a loss of comparability between the figures of individual Member States.

This approach has elements of the consumer profile approach but uses only one profile for compiling the index. It starts with the determination of a single profile (calling pattern) for the entire population, as is the case for weighting purposes in the traditional tariff approach, or the unit value approach. The profile is not dependent on the provider or particular tariff packages. In the next step the providers are selected by turnover, and within the providers the tariff plans are again selected by turnover, or alternatively, if turnover data are unavailable, by the revenue derived from charged minutes as an approximation. The weight for the product within the HICP basket of goods and services is defined at a higher level, e.g. wireless telecommunication services, in order to retain maximum flexibility within this approach.

In Table 12.6.5 the weights for the items/tariff elements are defined for the basic fee and the call charges. Within the items/tariff elements the weights for the computation between the tariffs and the providers may vary during the index period, still keeping constant the consumption pattern from some base period. The remaining aggregation is undertaken as usual using a Laspeyres approach. In the example the index is only computed for the call charges, the basic fee is left out of consideration. Therefore, the result is not directly comparable to the other computations in this chapter.

Table 12.6.5: The actual usage method, fixed line telephone charges

Period		1				2			
Provider		A	A	B	Total	A	A	B	Total
Tariff		1	2	3		1	4	3	
Item	Quantities	55%	44%	100%		58%	42%	100%	
Basic fee	200 000	15.00	10.00	13.00		15.00	11.00	13.00	
Domestic call	2 000 000	0.25	0.30	0.30		0.25	0.25	0.30	
International call	3 000 000	0.10	0.15	0.10		0.10	0.12	0.10	
Average of domestic and international calls only		0.16	0.21	0.18		0.16	0.17	0.18	
Average prices									
Provider weights		65.7 %	34.3 %	100 %		65.7 %	34.3 %	100 %	
Average price		0.18	0.18	**0.18**		0.17	0.18	**0.17**	
Index					**100.00**				**93.69**

Evaluation and recommended use of this method: If the method uses all consumer transactions supplied by service providers or the regulator to establish the consumer profile and if the profile is regularly updated the actual usage method may be considered an A method. If the profile is based on some other source like in-house judgements at the Member State, it is considered a B method. If there is no justification or rationale for choosing the profile, then this method is rated as a C method. The actual usage method can be applied in both stable and dynamic market situations.

12.6.6 Explanatory text

The following text explains the guidance given in each recommendation (1-4 and 6-8). Recommendation 5, index compilation methods is covered in Section 12.6.5 above. As several of the recommendations are intrinsically *linked* they should be read and understood as a whole.

12.6.6.1 Coverage (Recommendation 1)

The price index for telecommunication services (ECOICOP 08.3.0) should cover all significant (in expenditure terms) sectors of the telecoms market i.e. wired and wireless telephone services, internet services, and bundled telecom services (e.g. phone, internet and cable TV packages). See also Recommendation 6: the treatment of bundles and classification issues.

12.6.6.2 Weights and data sources (Recommendation 2)

Weights

Due to the dynamic nature of the telecommunications market, Recommendation 2 states that all 5-digit sub-class weights within ECOICOP 08.3.0, Telecommunication services should be reviewed annually and be updated as required. Depending on national circumstances, a finer stratification may be required to take account of the multitude of different services available within each sub-class. For example, within the wireless (mobile) telephone services sub-class there is often a clear distinction between pre-pay and 12/24 month contracted service plans. If this is significant in terms of relative expenditure shares in a Member State and if data for weighting are available, it is recommended that such stratification should be made.

Data sources for weights

Telecommunication services, unlike some other consumer services, are generally subject to strict regulation and/or very close supervision by national regulatory bodies, in addition, as all types of usage are recorded and charged for. As such, telecommunication providers collect detailed information on usage as an integral part of their operations.

Given the above, a large volume of very detailed information should be available for both choosing the sample of providers and call plans, and ascertaining typical usage patterns (for use in establishing consumer profiles), and for obtaining expenditures for use as weights. In this respect there is an overwhelming amount of data that are potentially available. It is important for index compilers to first understand the dynamics of their market before requesting data in order to minimise the burden on data suppliers by asking only for the information that is strictly required.

Service providers and regulatory bodies are therefore the obvious and recommended sources for detailed information on consumption patterns, weights and market developments in general. Developing and maintaining a good working relationship with service providers or regulatory bodies is therefore essential for obtaining the data required for ensuring the accurate measurement of price developments for telecommunication services. Additionally, data on market shares of providers and information about typical usage of telecommunication services may also be available from market research companies.

Article 4 of Regulation No 2646/98 obliges statistical units, such as providers of telecommunication services, to provide Member States with data at the required level of detail to implement the Regulation. This should aid in the collection of information, particularly for sampling and the compilation of internal index weights etc. In general, cooperation rather than the threat of legal action or sanctions should be the preferred option, as obtaining detailed relevant and good quality information on a regular basis requires the goodwill of service providers. However, it has to be recognised that not all service providers in all Member States may be willing to volunteer this information.

In larger countries where there are several providers, the national regulator may be best placed to provide information on the market shares of all providers operating on the economic territory. These data can be used for estimating the respective weights of the providers for each market sector (fixed line, mobile services etc.), as different providers may dominate different sectors of the market. For example, former state telephone companies that have been privatised may dominate the fixed telecommunications market, but may be less dominant in the mobile market. National regulators may also have information on national average consumption patterns for use in identifying consumer profiles etc.

Individual providers will hold detailed information on their product offers, and they may be the best source of information for both sampling representative call plans and tariff packages, and for providing information on the migration from old to new tariffs etc. (see Recommendation 4) They may also be able to help in identifying those packages which are mainly used by businesses, so that these can be excluded from the HICP. Caution should be taken in assuming that business users dominate high use profiles, as this may not always be the case given the rapid rise of social media and the downloading of music and video streaming etc., all of which can be data intensive. As such it is important to liaise closely with providers to develop a sampling frame of providers, tariffs and user profiles etc., which is representative of consumer behaviour.

The data available to index compilers will be dependent on both the prevailing market environment and the willingness of service providers to supply detailed data. As both these factors are likely to vary from one country to another, it is simply not possible to specify in detail what data sources should be used for each aspect of index construction for all countries. However, in general, a dual approach using information from national regulators for the higher level weights i.e. the market shares of service providers in each market sector, supplemented with information from service providers to both estimate detailed weights and to identify representative tariff packages, consumption profiles, and migration rates etc. should be used.

While revenue shares are the ideal, the number of subscribers for each provider could be used if information on revenue shares from national regulators is not available.

Where mobile telecommunication service providers are unwilling to provide information centrally, an alternative, but less than ideal, approach would be to consult the sales staff in the provider's high street outlets to identify the most popular service plans etc.

For price collection, the use of the internet is invaluable as all service providers and retailers maintain up-to-date websites in addition to physical outlets. Due to deregulation, it should also be noted that there may also be a number of large independent retailers, which sell telecommunication services from a range of providers. When investigating data sources for pricing telecommunication services, it is important that all retailers of such services are included in the sample if their market share is significant.

While the websites will advertise current prices, the prices that are still being charged to existing customers for older call plans should be collected directly from the service providers, as prices for these older call plans may be

subject to change. This is particularly important where binding contracts exist and where new call plans or tariffs are phased in using migration rates.

12.6.6.3 Sampling (Recommendation 3)

Recommendation 3 is closely linked to Recommendation 1 Coverage, in so far that the sample should include all significant (in expenditure terms) ECOICOP sub-classes. The sampling frame and sample (which could be in terms of consumer profiles, tariff elements, actual bills or a homogenous unit of consumption — for unit values) should be reviewed at minimum annually to keep the sample representative. In addition, because the telecommunication services and in particular the mobile telecommunications market, can be very dynamic, it is recommended to review and *if necessary*, update the sample more frequently than once a year if there have been significant changes to the tariffs offered on the market. Chapter 4 gives more advice on sampling strategies.

For example, in the area of mobile telephone call plans, the range of call plans offered from each sampled provider should be reviewed several times a year to identify when new or replacement call plans are introduced. How frequently these reviews are to be made should be determined by the nature of the market and the chosen compilation method. As data collection is normally undertaken using the websites of providers, it is generally very clear when new tariffs appear on the market and when old ones become unavailable to new customers. When a new tariff appears they may be included in the index through resampling if expenditure on them becomes significant (see Recommendation 4). In general replaced tariffs are not offered to new customers who only have the option of the new replacement tariffs. Thus price collectors, as part of the monthly price collection, should be trained to look out each month for both new and discontinued tariffs.

In stable markets conditions, it may only be necessary to review the sample every 6 months (i.e. in between the annual weights review each December). However, in dynamic markets new product offers are continually appearing on the market. While these may replace existing product offers, due to the presence of binding contracts, the prices of the replaced product offers are still relevant to many consumers. How to treat these replacements is the subject of Recommendation 4.

It is important to gain an understanding of typical consumer behaviour within their country. This is of particular importance in defining representative consumption patterns (consumer profiles).

Ideally as with the weights (Recommendation 2) the sample frame and sample should be based on relative revenue shares of providers/tariffs. However, if this is not available, then as with the weights, the number of subscribers to a service provider could be used as a proxy.

It is important when developing the sampling frame and during its review that all current providers are investigated to ascertain if their market share is or has become significant to warrant their inclusion in the sample.

12.6.6.4 Replacing tariffs and resampling (Recommendation 4)

As described above, frequent updating of the sample is needed to maintain the representativeness of the sample. In addition, from time to time completely new tariff elements also appear, which should also be included by resampling. Examples include Multimedia Message Services (MMS), and mobile internet data allowances, which at the time of their introduction could be regarded as newly significant product offers or services. Likewise, roaming charges should be included by resampling if their expenditure share is or becomes significant.

The need for frequent resampling is also influenced by the dynamics of the telecommunication markets. In more stable mature markets the choice of the price measurement method and the sampling frame is less sensitive than in dynamic markets.

There are two elements of resampling which are particularly relevant, firstly the introduction of new tariffs or tariff elements in between annual resampling, and secondly, annual resampling.

How should newly identified tariffs or tariff elements (call plans) be treated (included) in the sample when they occur in between the annual sample updates in December? The first issue to understand is the nature of the telecoms market and the contractual nature of the call plans. In general there are two types of market, stable and dynamic and two types of contract, binding and non-binding.

For all market conditions, it is important to note that new call plans or tariffs should not automatically replace existing call plans and tariffs in the sample. This is because the existence of binding or semi-binding contracts restricts the ability of consumers to switch or *migrate* from their existing call plan to a newly offered call plan, even if their existing call plan is no longer available to new customers. As a result both existing and new call plans and tariffs co-exist in the market and as such should be reflected and included in the sample. Over time, consumers will switch to the best available call plan or tariff as their contracts expire. If new call plans or tariffs immediately replace existing ones, then the resultant price change is very likely to overestimate the reality of the actual price changes occurring in the market.

In stable markets, if there is an absence of binding contracts, the reaction of consumers to market developments can be fairly instantaneous, as consumers will normally opt to choose the best tariffs available, though developments may be infrequent or insignificant. In such cases the design of the sampling frame is less sensitive to changes in the choice of tariffs sampled. This is because the differences between only selecting new tariff packages and selecting the packages by using the representativeness principle has only a slight effect on the measured inflation rate.

However, in reality, many consumers will be bound by contracts that stipulate a minimum length of, for example, 12-24 months and therefore may not be able to switch immediately to a cheaper tariff. The immediate replacement of existing tariffs with new tariffs in stable markets where binding contracts exist should only be made when evidence from service providers indicates that this reflects consumer behaviour.

According to Recommendation 4, the new tariff should be phased in preferably with the use of migration rates. Migration rates are the rates at which consumers switch from their existing tariff to a new tariff. The use of migration rates greatly improves both the traditional tariff method and consumer profile methods where binding contracts exist. They are not needed for either the unit value or actual usage methods as migration rates are taken care of as part of these methods (see Section 12.6.5 above). Preferably, migration rates should be evidence-based estimates i.e. are estimated from either data or advice supplied by service providers, rather than based on unsupported judgements. In general migration rates that are either supplied by, or are based on advice from providers, will reflect previous consumer behaviour rather than the current migration to a newly offered tariff from the tariff it replaced. If such advice or information is not available, then the use of a *rational consumer* approach is allowed as an alternative. If binding contracts are used, e.g. for a 12-month contract, it could be assumed that each month one-twelfth of the consumers switch to the new tariff. The length of time over which a new tariff plan fully replaces an older tariff is a matter of choice for the index compiler. Compilers should take into account both the length of the binding contract and in which month of the year the new tariff replaces an old tariff, as the tariffs priced should be completely resampled every December (see Recommendation 3). In practice this means the migration period can be a maximum of 12 months, but is more likely to be less than this for example 3 to 6 months. While this approach is clearly second best to evidence-based estimates, it is preferable to not using migration rates at all.

An important point to note in replacing tariffs and applying migration rates under the consumer profile approach is that the cheapest newly available tariff must meet the minimum requirements of the consumer profile of the existing tariff (regardless whether it perhaps includes more free minutes than the tariff it replaces), as sampled in the price reference period (i.e. the previous December). A new tariff which either does not meet the minimum requirements of the existing consumer profile or meets the requirements of another sampled (higher usage) consumer profile should not be selected as a replacement tariff. Annex 12.6.1 gives an illustrative (numerical) example of using migration rates when using a consumer profile approach. The same principle applies if the cost of the handset is included in the tariff as part of a bundle with no identifiable cost. In such cases as well as the tariff itself, the replacement phone should be of similar type to the one included in the replaced tariff, i.e. if the replaced tariff includes a free iPhone, then the replacement tariff should also include a free iPhone (preferably of the same model or its latest replacement); it should not be replaced with a more basic non-smartphone for example. In this way, the quality differences between the replaced and replacement phone plus call plan bundle are minimised if not completely eliminated.

Where the traditional tariff pricing method is employed in stable markets, the quality adjustment procedures used will be dependent on the differences between the old and new tariff, and should be consistent with the procedures as laid out in Article 5(2) of Regulation No 2646/98 (see Recommendation 8 and Chapter 6 and Section 7.4).

For all the other methods including the consumer profile approach, no quality adjustments are required when replacing tariffs (see Recommendations 5 and 8).

In dynamic markets where binding contracts are present as described above, new tariffs should not immediately replace existing tariffs but should be phased in. There are some exceptions, for example, some service providers

may regularly review customer's usage and will automatically migrate customers to their best tariff; these can be seen as a type of semi-binding contract. However, the generality of this recommendation remains valid. It is important to note that replacements in this context should only be made within the *same* provider and not *between* providers, as consumers generally only switch providers when they are free from their contracts.

The sampling principle for choosing packages in the sample, i.e. following new tariffs only or following representative tariffs, is far more critical in these situations. This is because binding contracts for a number of months may make the old tariff more representative than the new tariff (until significant numbers of customers have migrated to the new tariff). In this case, dynamic situations/markets, traditional pricing methods such as the tariff approach may not be appropriate, as they may not keep up with the dynamics of this sector. Given the above, in dynamic markets it is advisable to regularly review (at least quarterly) what product offers are currently on the market and resample as required.

In all markets, it is important that the entire sample of tariffs priced is reviewed completely each year (in December) to maintain representativeness. Representativeness in this sense refers to pricing *consumption patterns*, which reflect consumer behaviour — which is changing rapidly. It also refers to the sampling of those tariffs and providers, which consumers are actually using in the price reference month of the index.

12.6.6.5 The treatment of bundles and classification issues (Recommendation 6)

The treatment of bundled products is intrinsically linked with their classification within ECOICOP. The telecommunications market, ECOICOP 08.3.0, is divided into the following five sub-classes:

08.3.0.1 Wired telephone services: i.e. fixed telephone line services from a fixed place of origin. Includes; line rental, talk plans, public and hotel phone charges, and hire and installation of equipment. In addition to full service providers it includes call-by-call and pre-selection providers.

08.3.0.2 Wireless telephone services: mobile communications i.e. from a flexible point (mobile) of origin. Includes the cost of mobile phone handsets ([134]) if included in the subscription costs, covers all calls and text and media messages.

08.3.0.3 Internet access provision services: wired and wireless (mobile) internet access.

08.3.0.4 Bundled telecommunication services: includes telephony/internet/ television packages.

08.3.0.5 Other information transmission services: Telegraphy, telex, telefax services and Voice Over the Internet Protocol (VOIP).

Recommendation 6, the treatment of bundles, should be read in conjunction with the recommendations on bundles (2010), which are given in Section 7.6. Recommendation 6 describes the two types of *bundle* frequently occurring within the telecoms market and gives guidance for the classification of telecommunication product offers which cover more than one sub-class.

Pure bundles are bundles of services that are only available as a bundle and for which the constituent services are not sold separately. The expenditure should be allocated to the ECOICOP sub-class according to the purpose of the main component.

The main component is that part of the bundle which accounts for *primary* purpose of the service. The primary purpose may be either based on the product itself e.g. mobile phone call plan, where the primary purpose for most consumers is making calls, even if a data allowance is included. Alternatively, the primary use may be derived from information supplied by service providers.

There are two exceptions. Mobile call plans often include mobile internet and these bundles are to be included in wireless telephone services (ECOICOP 08.3.0.2), regardless of the importance or weight of the two components. This recommendation is not fully in line with ECOICOP where internet services, wired or mobile should be classified to ECOICOP 08.3.0.3 Internet access provision services. However, in most Member States mobile internet services are sold as part of a pure bundle, the elements of which cannot be separately identified. To ensure international comparability, Recommendation 6 states that these expenditures should be allocated to wireless

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([134]) Includes smartphones. If the cost of the handset is clearly identifiable, handsets should be classified to ECOICOP 08.2.0.2 mobile telephone equipment.

telecommunication services ECOICOP 08.3.0.2. ECOICOP does, however, recognise that in some cases call plans include the cost of the handset. Call plans that include the cost of a mobile telephone handset as part of a pure bundle are also to be included in wireless telephone services.

Mixed bundles are products which are sold both in bundles and separately, as stand-alone products. The expenditure on stand-alone products belongs in their respective ECOICOP sub-classes.

The expenditure of mixed bundles should be dealt with according to the Recommendations on the treatment of bundles 2010; unless the constituent components can be weighed and itemised easily, the bundle should be allocated to the ECOICOP sub-class according to the purpose of the main component. Chapter 7.6 discusses the treatment of bundles in detail.

Mixed bundles that include combinations of telephony, internet and television are allocated to ECOICOP 08.3.0.4 Bundled telecommunication services, regardless of whether the constituent services can be itemised.

The last sub-class 08.3.0.5 Other information transmission services, is likely to be insignificant in terms of household expenditure in most Member States. Note that Voice Over the Internet Protocol (VOIP) is a commonly used technology for fixed line communication and should be classified in 08.3.0.5 if used for stand-alone products. The technology is often used to offer fixed telephone services as part of a bundle with internet and/or television, in which case it should be classified in 08.3.0.4.

The treatment of bundles in the index compilation is not always straightforward, especially if information on actual usage is lacking which makes it difficult to determine the main purpose.

Any further subdivision of ECOICOP may not be needed or feasible due to a lack of information. Whether or not consumption segments are used for initial sampling and replacement depends on the information available to the Member State and the compilation method used. As the methods generally use either consumer profiles or tariff structures, the actual information available to make those profiles and structures will determine the level of segmentation that is possible to achieve.

12.6.6.6 The treatment of discounts (Recommendation 7)

The treatment of discounts is a separate issue from the treatment of replacement tariffs (see Recommendation 4 above). Often providers will offer various inducements and promotions to attract customers that do not bear directly on the main service provided, e.g. a temporary free use of music streaming etc. As with all other goods and services in the HICP, price discounts for telecommunication services should be reflected in the HICP (HICP rules on the treatment of discounts are given in Chapter 5). However, without information on actual usage it may be difficult to estimate the necessary adjustments. It is recommended to focus on those discounts directly related to the principal service, i.e. that have either a direct effect on the price (e.g. €10 discount on the monthly fee for the first 6 months) or have a direct effect on the main components of the service (additional free download allowance, free minutes etc.). Other discounts should only be included if they have an empirically justified significant impact on the price.

Typical examples include a discounted monthly charge for a fixed line telephone and broadband internet package, or bundled TV packages etc. for the first 'x' months of a contract.

Table 12.6.6 gives a typical example of such a discount. In this example broadband internet is offered at half price for six months and full price after that, within a 12-month broadband and wired telephone line rental contract. While such examples are common, they are also relatively easy to capture in the index.

Table 12.6.6: 12-month broadband and landline rental contract with six months half price broadband

	Euro per month, for the first 6 months	Euro per month, thereafter
Broadband charge	5	10
Land line rental	10	10
Total cost	15	20
Index	100	133.3

Where *free minutes* are temporarily offered by way of a discount, as opposed to a permanent change to the tariff usage allowance i.e. they are not normally a part of the call plan, then adjustments should be made to the calculation to reflect the discount. If an average consumer-profiles approach to index calculation is used, then the average discount has to be estimated and included into the aggregation. Implicit assumptions may be required to apportion discounts appropriately between the profiles included in the index. In general, discounts tend to be offered for limited time periods and adjustments to the index calculation must be reversed as and when discounts are no longer offered.

12.6.6.7 Quality changes (Recommendation 8)

In the telecommunications sector, there are two kinds of quality changes: horizontal and vertical quality changes.

- *Horizontal quality changes* are changes that affect all customers or the entire network. For example, changes in terms of sale of a service plan or an increase of internet speed across the network. In principle, quality adjustments should be made if such changes are perceived as improvements for which the customers will derive an added benefit. However, for practical reasons, adjusting for these improvements is not feasible, as the service received by consumers is often dependent on their current location, distance from the telephone exchange, type of handset and the current level of network usage, etc. In addition, network improvements are often rolled out sequentially over a number of years.

- *Vertical quality changes* are changes in the characteristics between a replaced and a replacement tariff package. Dependent on the pricing method used, quality adjustments should be made for such changes. Examples include the introduction of new regional borders, the type of internet connection (ADSL replaced by fibre broadband) or the introduction of new time windows within tariff structures e.g. the definition of *off-peak*. Not everyone considers these types of changes as quality changes but alternatively describe them as quantity changes. For example, home broadband speed may be increased, but the basic service of internet access is unchanged, thus the consumer receives an increased quantity of broadband rather than an increased quality of service. It should be noted here that some changes have little or no impact on consumers, and are more marketing strategies than effective quality changes, introduced in order to sweeten the effects of other underlying changes. For example, if a mobile call plan's allocation of included SMS increases from 5 000 per month, to unlimited and the average number of texts made by a customer is 300 a month, then there is no real benefit that is derived from the change in the plan and as such the change in allocation could be ignored.

In both cases, the use of overlapping linking methods between new and replaced tariffs to show no price change should generally be avoided unless it can be justified.

From the above it can be seen that the term *quality change* covers both real differences in quality, and changes in service plan characteristics between the replaced and replacement tariffs.

For telecommunication services, clearly both horizontal and vertical quality changes are occurring on a continuous basis. While it may not be practical in all cases to adjust for horizontal changes, vertical quality changes should be taken into account following the general rules of quality adjustment (see Chapter 6). For both types of quality change a variety of explicit and implicit quality adjustment methods are available; the chosen method will depend on the information available to make the adjustment. As with other index areas, explicit methods are preferred over implicit methods where feasible. How this should be done will largely be dependent on the pricing approach adopted.

- *The tariff approach:* This is often the preferred approach for fixed (wired) telecommunication services. Regulation No 2648/98 gives guidance on the treatment of changes to tariff elements. In particular, Article 5(2) states that:

  'if a component element or a unit of consumption changes with respect to its specification, or a new component element is added which does not constitute a new good or service for the consumer, then the price change shall be computed with weights corresponding to the expenditure of preserving the pattern of consumption applying during a period, up to one year, preceding the change. The adjustments for specification changes shall be consistent with quality adjustments made for other sub-indices'.

- *The consumer profile approach:* This approach is frequently used for bundled mobile telecommunication services. Vertical quality changes can occur when new or replacement tariffs comprise changed allowances

for inclusive minutes, texts and internet usage etc. The consumer profile approach aims to measure the change in the minimum cost of a fixed basket of consumption. This can be different to the price development of mobile service plans. This measurement aim sets the consumer profile approach apart from the treatment of other goods and services, which would traditionally aim to follow the price development of a specified product offer. If a replacement service plan covers the specified consumption pattern (consumer profile), even if the number of included minutes etc. has changed, then this is the minimum price offered by the selected provider for the specified profile of consumption, and the price of the new service plan should be taken into the index without adjustment. This is because it is the cost of the consumer profile and not the cost of the service plans which is the target measure of this approach. Vertical quality changes as such should not be made under the consumer profile approach. However, in theory at least, horizontal quality changes should be taken account of, but as already noted this may not be practical given the number of variables and service plans involved.

- *The unit value approach:* In this approach the unit value or average of all transactions are followed for tightly defined homogeneous services. As all transactions are covered, vertical but not horizontal, quality changes are implicitly included in this approach.

- *The actual usage/sample of bills/comprehensive basket approach:* This approach uses just one profile for the entire population and makes use of all or nearly all transactions. As such, like the unit value and consumer profile approach, vertical but not horizontal quality changes are implicitly included.

A special case for quality adjustment for all telecommunication services is the introduction of flat rates and fair use policies. Without detailed information on the actual usage, it should not be assumed that a large change in consumer behaviour will follow the introduction of such policies. In the absence of information on actual usage, it should be assumed that usage remains stable during the transition.

The coexistence of old and replacement call plans, which can overlap for many months, further complicates any potential quality adjustment when replacing tariffs. Where feasible, quality adjustments that can be made, should be made. It is clear that the dynamics of the market require that the sample requires frequent updating within a well-structured resampling and replacement regime (see Recommendations 4 and 5). Such a regime should not be seen as an alternative to quality adjustment but is an integral part of quality adjustment. This is because it maintains the representativeness of the sample, thus reducing the need for quality adjustments to be made.

Annex 12.6: Mobile telecommunications: the use of migration rates, an illustrative example

In the following simplified example, the use of migration rates within a consumer profiles approach to measuring mobile phone call plans is illustrated.

In this example there are two providers I-Tel and Global. For both providers, binding contracts exist, and customers are not allowed to switch their tariff (call plan) during their contract.

In Table 12.6.1.1, service provider weights are estimated from each provider's customer base. Ideally, however, weights based on revenues should be used if available, otherwise as in this example, the number of subscribers can be used as a proxy.

In Table 12.6.1.2, three consumer profiles are presented: low, medium and high usage. This information should normally be based on typical patterns of consumption estimated from data supplied from either the service providers or from the regulator. For the purpose of this example, the profiles consist of three elements that are included in each of the plans: the inclusive number of minutes, SMS/text messages, and mobile data (internet) allowance.

In Table 12.6.1.3, the packages selected in the price reference month (December) of the index are shown. The plans selected from each provider are the cheapest tariffs that meet the minimum requirements of each consumer profile (even if the number of included minutes changes) while not exceeding the requirements of a higher usage profile. For example, Red 1 and Talk 100 are to be included in the sample since their included minutes is above the 60-minute minimum threshold of the pre-defined low-usage profile, but below the 150-minute threshold of the

medium usage profile. In April, both service providers replace some of the existing tariffs with new tariffs, which are only available to new customers. In this example, for I-Tel, the Red 2 tariff replaces the Red 3 tariff. While there is a change in both the SMS allowance and inclusive call minutes, the replacement tariff still meets the minimum requirements of the specified consumer profile for the current year. Likewise for Global, the Talk 100 tariff is replaced by the Talk 60 tariff, which again is the cheapest tariff that meets the minimum requirements of the profile.

In Table 12.6.1.4 the profile weights for each provider are given. These should ideally be based on their relevant revenue shares, as estimated from data supplied from service providers.

Table 12.6.1.5a shows the prices actually charged in each month and for each tariff before migration rates are applied.

Table 12.6.1.5b estimates the migration rates between the replaced and replacement tariffs. In this example, a rational consumer approach is adopted where over a 12-month contract, one twelfth of existing consumers on the old tariff (call plan) switches to the new tariff. The calculation works as follows: for both the replaced and replacement tariffs, the cost of one twelfth of the monthly cost is estimated. In the first month that the replacement tariff is priced, the price that enters the index is comprised of 11 twelfths of the replaced package and one twelfth of the replacement tariff. After that, in the following months, the proportion of the new tariff in the combined price increases by a twelfth until after 12 months the price used in the index is the total price of the replacement tariff.

In Table 12.6.1.6a the elementary aggregate price indices are calculated for each service plan. Table 12.6.1.6b weights the elementary aggregate indices together to produce price indices for each provider. Finally, in Table 12.6.1.6c, the price indices for each provider are weighted together to produce an overall mobile telecoms index.

Table 12.6.1.1: Provider weights

Providers	Number of customers (thousands)	Market share (per cent)
I-Tel	1 275	58
Global	920	42
Total	*2 195*	*100*

Table 12.6.1.2: Typical consumer profiles

	Based on the typical usage of consumers		
	Low	**Medium**	**High**
Minutes	60	150	500
Texts/SMS	100	500	Unlimited
Data	50 Mb	500 Mb	2 Gb

Table 12.6.1.3: Selection of packages to be priced

If a handset is typically included in the package this must be specified and held constant. Packages to be selected — the cheapest package from each provider that meets the minimum usage profile. Replacement packages must be from the same provider.

I-Tel	*Low*	*Medium*	*High*	Global	*Low*	*Medium*	*High*
December	Red 1	Red 3	Red 5	**December**	Talk 100	Talk 180	Talk 600
Minutes	75	250	1 000	**Minutes**	100	180	600
Texts/SMS	150	Unlimited	Unlimited	**Texts/SMS**	250	500	Unlimited
Data	50 Mb	500 Mb	2 Gb	**Data**	50	500 Mb	3 Gb
April	Red 1	Red 2	Red 5	**April**	Talk 60	Talk 180	Talk 600
Minutes	75	200	1 000	**Minutes**	60	180	600
Texts/SMS	150	500	Unlimited	**Texts/SMS**	200	500	Unlimited
Data	50 Mb	500 Mb	2 Gb	**Data**	50	500 Mb	3 Gb

Table 12.6.1.4: Profile (usage) weights

I-Tel	Low	Medium	High	Global	Low	Medium	High
	25	40	35		30	50	20

Table 12.6.1.5a: Pricing of packages

I-Tel	Low	Medium	High	Global	Low	Medium	High
Price (Euro)	Red 1	Red 3	Red 5	Price (Euro)	Talk 100	Talk 180	Talk 600
Dec	20	35	60	Dec	18	30	55
Jan	20	35	60	Jan	18	30	55
Feb	22	35	65	Feb	18	30	55
Mar	22	35	65	Mar	20	32	60
		Red 2				Talk 60	
Apr	22	34.83	65	Apr	19.58	32	60

Table 12.6.1.5b: Use of migration rates (if available)

Ideally should be based on migration rate information supplied by telecoms companies. The assumption: one-twelfth switch each month.

I-Tel Red 3	Price	One-Twelfth	Proportion switching (Twelfths)	Estimated combined price	Global Talk 100	Price	One-Twelfth	Proportion switching (Twelfths)	Estimated combined price
Mar	**35**	*2.92*			Mar	**20**	*1.67*		
Red 2					**Talk 60**				
Apr	**33**	**2.75**	1	34.83	Apr	**15**	**1.25**	1	19.58
May			2	34.67	May	15		2	19.17
Jun			3	34.50	Jun	15		3	18.75
July			4	34.33	July	15		4	18.33
Aug			5	34.17	Aug	15		5	17.92
Sept			6	34.00	Sept	15		6	17.50
Oct			7	33.83	Oct	15		7	17.08
Nov			8	33.67	Nov	15		8	16.67
Dec			9	33.50	Dec	15		9	16.25
Jan			10	33.33	Jan	15		10	15.83
Feb			11	33.17	Feb	15		11	15.42
Mar			12	**33.00**	Mar	**15**		12	15.00

Table 12.6.1.6a: Index calculation, profile indices

	Red 1	Red 3	Red 5		Talk 100	Talk 180	Talk 600
Dec	100.0	100.0	100.0	**Dec**	100.0	100.0	100.0
Jan	100.0	100.0	100.0	**Jan**	100.0	100.0	100.0
Feb	110.0	100.0	108.3	**Feb**	100.0	100.0	100.0
Mar	110.0	100.0	108.3	**Mar**	111.1	106.7	109.1
		Red 2			Talk 60		
Apr	110.0	99.5	108.3	**Apr**	108.8	106.7	109.1
Profile weights	25	40	35		30	50	20

Table 12.6.1.6b: Index calculation, provider indices

I-Tel		Global	
Dec	100.0	**Dec**	100.0
Jan	100.0	**Jan**	100.0
Feb	105.4	**Feb**	100.0
Mar	105.4	**Mar**	108.5
Apr	105.2	**Apr**	107.8
Provider weights	*58*		*42*

Table 12.6.1.6c: Overall mobile telecoms index

Dec	100.0
Jan	100.0
Feb	103.1
Mar	106.7
Apr	106.3

12.7 Clothing and footwear

12.7.1 Introduction

Clothing and footwear is generally regarded as a difficult area for price measurement. The usual reasons given for this are seasonality, the importance of fashion and style, and frequent sales periods.

Clothing and footwear raise particular issues for consumer price measurement, since fashions and styles can evolve rapidly. This takes place within a market that in many countries has a strong seasonal nature, with a particular risk of measurement bias related to seasonal sales.

This section describes the treatment of clothing and footwear in the HICP, focusing particularly on product replacements, quality adjustment, seasonality and sales prices.

It can be noted that some issues discussed in this section concern clothing more than footwear, as fashion and style changes are generally more prominent in clothing than in footwear.

12.7.2 Legal requirements

Apart from Commission Regulation (EC) No 330/2009 of 22 April 2009 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of seasonal products in the Harmonised Index of Consumer Prices (see Section 7.1), which can apply to clothing and footwear, there are no other HICP legal rules specifically relating to these product groups.

Clothing and footwear are included in ECOICOP Division 3: Clothing and footwear.

12.7.3 Definitions

Fashion: in general means temporarily varying consumer preferences (as treated in Section 6.3.5), especially in clothing, footwear, accessories, cosmetics and the like, typically featured in media and advertising.

Style: means a manner of doing or presenting things, typically modified and customised on an individual level to suit each person's preferences.

Fashionability: means the condition of a product model of having characteristics being in line with currently prevailing consumer preferences.

12.7.4 HICP standards for clothing and footwear

In 2005 standards for the treatment of clothing and footwear in the HICP were agreed by the Price Statistics Working Group. These standards have not been published and are not legally binding but can serve as guidance as to what represents good practice and how to fulfil the requirements of relevant HICP regulations.

12.7.4.1 Article 1, Aim

The aim of the standards:

> '… *is to specify aspects of the treatment of clothing and footwear (COICOP 03) in the HICPs, in particular concerning sampling and quality adjustment, to ensure that the HICPs are reliable and relevant and meet the comparability requirements laid down in Article 4 of Council Regulation (EC) No 2494/95.'*

12.7.4.2 Article 2, Definitions and Article 3 Classification [of quality adjustment] methods

Articles 2 and 3 define and classify quality adjustment methods commonly used in the clothing and footwear field. These methods and their potential use are described and discussed in detail in Chapter 6.

12.7.4.3 Article 4, HICP standards for clothing and footwear

Article 4 provides five paragraphs with specific standards for the treatment of clothing and footwear in the HICP, as follows:

Coverage

> '1. *By Commission Regulation (EC) No 1749/96* [initial implementing measures], *in particular Articles 3, 4 and 8, both seasonal and non-seasonal clothing and footwear are covered by the HICPs. When it is in-season and available for purchase by consumers, seasonal clothing and footwear shall not be excluded from price collection for the HICPs, as the HICPs shall be representative of households' expenditures on all types of clothing and footwear.'*

This standard states that seasonal products of clothing and footwear should be included in the HICP in addition to non-seasonal products of clothing and footwear.

For many but not all types of clothing and footwear there is a regular seasonal pattern where winter clothes and footwear follow after summer clothes and footwear, and vice versa, with a characteristic seasonal pattern of price movements. At the start of each season, new fashion articles are introduced at relatively high prices, and during their shelf life (i.e. period of availability) they may be reduced in price. Often at the end of the season, remaining articles still available may be sold at very low prices before disappearing entirely from the market.

This regular pattern complicates traditional price collection methods where the aim is to follow the price of a specified product offer over time. For most other products, if a product offer needs to be replaced then it is normally straightforward to find either a comparable replacement, or a replacement which is made comparable through quality adjustment (see Chapter 6). For clothing this is often not possible as many of the products offered for sale change with the seasons. Regulation No 330/2009 on the treatment of seasonal products specifically refers to treatment of clothing and footwear (see Section 12.7.5).

Fashion and obsolescence

> *'2. For clothing and footwear the decline over time in prices for models or varieties due to increasing obsolescence or lesser fashionability shall be treated as a genuine price change and not as a decline in quality. Symmetrically, the increases in prices that may be seen at the introduction of a new model or variety shall be treated as genuine price changes and not as changes in quality.'*

Fashion constitutes temporary or transient consumer preferences (see Section 12.7.3 above and Section 6.3.5), and particularly in clothing it refers to the design and appearance of garments which are frequently changed. More popular models will sell out fairly early in the season and will be followed by the same or similar models. Less marketable models may be reduced in price as the season proceeds. Fashionability generally declines as the months pass after a garment first appears. This is particularly the case for seasonal products such as a summer blouse or a winter scarf, and price decreases reflect this fact. Prices at the end of a season are largely sales prices, while prices of the following season's clothes are regular prices (see below — sales prices). However, products such as underwear and socks, which are purchased all year around, are less affected by seasonal and fashion variations.

This standard states that changes in fashionability are not quality changes. The reason for this is explained in Section 6.3.5. Therefore, a loss of fashionability is not considered a quality change but treated as a genuine price change, and thus price reductions that occur through the season should be shown in the HICP. Likewise, the introduction of new season fashion lines are also not to be treated as an improvement in quality, but rather they should be recorded as genuine price increases.

In practice, the introduction of new fashions at the beginning of a season provides retailers with their main opportunity for price increases. Such increases are in general less visible than increases on continuing non-seasonal lines.

As fashion is a major factor in the clothing market, the change in prices of such products should be represented in the HICP. The clothing sub-indices should cover fashion clothing on the grounds of both comparability and representativity. Their sales volume is significant and their price development could differ from other prices.

It should be noted that the overlap period between seasons can be problematic because both old and new season's products co-exist, often with very different prices, with new season fashion products sold at regular (non-discounted) prices and old season less fashionable products mostly sold at sales prices. In these circumstances there is risk of a downward bias in the index, unless the price increase in the seasonal shift is fully shown in the index. To prevent this potential bias, it is important to avoid having chain links that are simultaneous with shifts of seasons. Indeed, at shifts of season the price change should be shown in a product replacement with direct comparison or quality adjustment. (See the last paragraph of the explanation to paragraph 4 below, and also Sections 12.7.4 quality adjustment and 12.7.5 seasonality.) As December — the link month for the HICP — does not normally coincide with the start of a new season this potential bias is generally not an issue.

Sales prices in clothing and footwear should be included in the HICP on the grounds of representativity, as they usually account for a large proportion of clothing and footwear expenditure. The total value of purchases at sales prices may even be greater than the value of purchases at regular prices.

For the treatment of sales and discount prices in clothing and footwear in the HICP, Commission Regulation (EC) No 2602/2000 of 17 November 2000 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of price reductions in the Harmonised Index of Consumer Prices applies (see Section 5.3.3).

Regularly occurring sales prices in clothing and footwear are in many countries observed once or several times a year. More competition and deregulation can lead to an increase in the use of discounts and extension of sales periods. In some countries, the timing of sales prices can be fixed by legislation. In other cases, the timing or the scale of sale price reductions may differ from year to year, which can also affect annual inflation rates.

A new season's clothing range may appear in outlets either immediately after the end of a seasonal sale, or after an intermediate period, or while the sale is still going on. As well as end-of-season sales, there may be minor sales, mid-season sales, campaigns and promotions at other times, which can vary from year to year. The timing of sales and the introduction of a new season's clothing range may not be synchronised between outlets. Additionally, some products *on sale* may be *special purchases* or *clearance sales* of models that were not available before the sale.

Such *special purchases*, which are only sold during sales alongside products whose prices have been reduced, should not normally be included in the price collection, as they are not likely to be selected in the target sample.

They should normally not be selected for replacements either, as they remain available only for very short periods, are often unrepresentative and quality comparisons with other products would be problematic.

Sampling, stratification and replacements

> *'3. In order to select comparable replacements, and in order to decide which models are essentially equivalent and which are not, broad segments of the clothing and footwear markets shall be defined by identifying the most important quality and price determining characteristics. Hedonic methods offer a potentially useful tool for deciding which characteristics may be used for this.*

> *4. Replacements shall as far as possible be essentially equivalent, so that direct comparison may be used. It is usually possible, when newly introduced fashion models replace previous models, to select in a particular outlet a new model or variety that is directly comparable, that is essentially equivalent to the previous one and broadly equivalent in fashionability as the old model or variety was when it entered into the sample.'*

When a specific product offer/product model has been selected for pricing in a specific outlet, and if it disappears from the shelves within a few months (which is often the case), it is common practice that a replacement model is selected in the same outlet. The replacement product model should be both representative of current purchases (well sold) and directly comparable with the disappeared model. As with other product areas, the replacement model should be selected from the same consumption segment as the replaced model (see Section 4.2.3). For example, relatively casual and relatively luxurious garments are likely to be in different consumption segments and should not be selected as direct replacements for each other. If the replaced and the replacement model are judged to be incomparable, some quality adjustment should be made. (See Chapter 6 — quality adjustment and replacements.)

It is often possible, when newly arrived fashion models are introduced after preceding fashion models disappear or are sold off in clearance sales, to select in a particular outlet a new model that is essentially equivalent to the preceding one and just as fashionable as the preceding one when it was first introduced. Nevertheless, it is important to be aware that quality changes can occur for clothing and footwear too, e.g. if there is a shift in the market to cheaper or more luxurious materials.

In relation to quality, the distinction between fashion and fashionability should be noted. In some ways, fashion is not quality; that is, temporarily preferred specific product characteristics do not constitute quality. In contrast, fashionability, given that it is the condition of a product having characteristics in line with current preferences, whatever they are, does constitute a form of quality. For example, a particular colour is not an aspect of quality, but the adaptation of the colour to current preferences is an aspect of quality, even if it is a temporary and changing aspect of quality. However, due to the temporary and transient nature of fashionability, changes in the fashionability of a garment through time should not be subject to any form of quality adjustment.

Selecting an essentially equivalent model can be somewhat demanding for the price collector. There has to be a common understanding of what *essentially equivalent* means. It normally does not mean, for example, that an initially sampled men's shirt can be directly compared with any other men's shirt, because there may be real differences in quality. The guiding principle is consumer perception and consumer satisfaction (of quality), so what is *essentially equivalent* should be viewed from the consumer's perspective.

Often outlets sell products within a specific *quality range*. Then replacements within the same outlet are often viewed as essentially equivalent from the consumer's point of view even if the style, fashionability or even fabric changes, which is often the case. If a replacement has to be made from a different outlet, care should be taken to select an outlet which sells clothing of a similar perceived quality as the replaced outlet. For example, it would generally not be adequate to replace an H&M outlet with a Versace outlet. Although price collectors may at times be uncertain about what is essentially equivalent, their decisions using common sense as consumers themselves is on the whole adequate, if they are suitably instructed.

In order to help the price collector with this demanding task, detailed product specifications, which are provided centrally, are essential. Appropriate product specifications are needed for price collection in physical outlets, for central price collection and price collection from the internet or catalogues etc. (See Chapter 5.)

The product specifications should reflect the most important price and quality determining characteristics. However, if product specifications are too detailed there is a risk that price collectors cannot find models fitting the specifications or select wrong models. During price collection, the prescribed product specifications should normally be augmented by the price collectors (whether local or central) with more detailed descriptions of the

products actually priced, to make sure that identical or comparable models are followed over time (see Chapter 5). This additional information is also required for replacement and quality adjustment purposes (see Chapter 6).

In principle hedonic methods offer a potentially useful tool to help decide which characteristics are in effect price-determining, but this approach can be demanding in terms of both data and head office resources. The benefits of using this approach need to be balanced against the costs involved.

If the product specifications are tight enough, models fitting the specifications could in principle be regarded essentially equivalent and prices could be directly compared and any quality changes falling within the specification could then be ignored. Too loose specifications may lead to accepting too much qualitative variation and the risk of introducing some quality bias into the index. Too tight specifications on the other hand may lead to too many missing prices, as at times there may not be any models meeting a tight specification. Perhaps more importantly, the market may evolve e.g. materials may change between seasons, e.g. pure cotton fabrics are succeeded by cotton & mixed fibre fabrics. In such cases the use of overly tight specifications can lead to a loss of representativity.

Specifications of *representative products* serve to define the sets of products within which models are to be selected for price collection. They should be related only to those characteristics which price collectors can readily identify. What these are depends partly on the training given to price collectors and partly to the time available for the collection.

Brand-class and outlet-type are among the most important characteristics. One possibility is to classify brands into quality groups (using trade expertise) and instruct the price collector to replace a discontinued product offer by a product offer within the same brand/quality group, as far as possible. For unknown brands, the country of origin has been seen as an alternative approach. However, as clothing manufacture is now a truly global industry, the use of country of origin or manufacture could be questioned if applied without proper justification. For example, expensive branded sports shoes are often manufactured in low wage countries.

A distinction can be seen between country of origin and country of manufacture. Country of origin of a brand is in principle the country that the brand is originally from or where the headquarters of the company owning the brand are located. Country of origin normally influences consumer perception of product quality and purchase intention. Country of manufacture of a product is the country where the product is primarily manufactured and is not in itself an indication of quality.

Replacement product offers should normally be selected within the same outlet, as it could be problematic to quality adjust for differences between outlets in terms of consumer perception and service level etc. Which other product characteristics should be taken into account depends on the kind of article. For men's suits, it is probably adequate to distinguish between 100 % woollen suits and other suits. The aim is always that the replacement product offer or product model lies within the same consumption segment as the replaced model.

Chain-linking and replacements

When periodic resampling and revision of product specifications is undertaken, the usual procedure links the newly selected basket to the preceding one using an overlap between the two. This entails a potential risk for a downward bias if the preceding basket is dominated by sales prices and the newly selected basket is dominated by high introduction prices. Therefore, resampling in sales periods should be avoided to prevent chaining out the true price development at the basket renewal. Furthermore, a correction for the different amounts of sales prices may be needed to compensate for a potential bias. However, this should not generally be a major issue since the link month of December normally does not coincide with the start of a new season.

Quality adjustment

Methods for quality adjustment and related concepts such as replacements are defined in Chapter 6. Concepts related to seasonality are defined in Section 7.1. It should be noted that the need for quality adjustment for clothing and footwear is relatively rare compared to some other product areas, and where it is performed it should be based on well-founded grounds. For example, the inclusion of a belt with a pair of trousers that were previously sold without a belt etc.

> '5. For clothing and footwear, quality adjustment methods are classified as follows:
>
> > a) The use of hedonic methods for clothing is classified as an A method, albeit it is recognised that Member States may face particular technical difficulties in applying hedonic methods for clothing and footwear.

b) *The use of the direct comparison method for all or the large majority of replacements, those which can be deemed essentially equivalent, in combination with the use of bridged overlap or class mean imputation in only those cases where a replacement model differs significantly from the replaced model, is classified as a B method.*

c) *The automatic or default application of the bridged overlap method, for example as a default method on all or most occasions when a substitution takes place, is classified as a C method. This method should be used only in exceptional cases, and only if a directly comparable replacement cannot be made. The overlap and link-to-show-no change methods are also classified as C methods. Applying the overlap method between the sales prices of old collection models and the higher introduction prices of new collection models can result in a significant downward bias.'*

General considerations for quality adjustment of clothing and footwear

Clothing and footwear present a particular challenge in quality adjustment. This is due to the delineation of quality with respect to fashionability or style, where the same product over time would not be of *constant quality*, while a fundamental principle of a price index is that products priced should be of constant quality.

As noted above, the *change* in fashionability of a specific garment through time is not considered a quality change and should not be adjusted for (see Article 4(2) of the standards for clothing and footwear; see also Section 6.3.5). For example, if a model of skirt has become less favoured than before by being shorter than models of skirt introduced later, the price of the model is not adjusted for that.

A quality adjustment is only appropriate when changes in product characteristics imply a permanent improvement or worsening of user functionality. For example, this can be the case when the material of the replacement model is superior or inferior to that of the replaced model with respect to durability or user functionality, e.g. if a breathable fabric replaces a non-breathable fabric in a rain coat. Where changes in product characteristics such as material in the replacement model are more in fashion or do not change user functionality, quality adjustments are not required e.g. if the cotton/elastin mix in a pair of cotton rich socks varies between the replaced and replacement product offer. In replacements where product offers are not essentially equivalent as they are too dissimilar in their physical characteristics or consumer perception, a quality adjustment is required to remove the value of the quality change. For example, this can apply where a wool/nylon mix coat is replaced with a pure wool or wool/cashmere coat of a perceived higher quality brand within the same consumption segment.

Chapter 6 describes in detail the quality adjustment methods that are commonly used. Article 4(5) of the clothing and footwear standards (quoted above) classifies (rates) the available methods in terms of their applicability to the clothing and footwear area. These are discussed in turn below.

Hedonic methods: Article 4(5a)

Like other methods, hedonic quality adjustment methods remove the price change attributed to the quality change by multiplicatively or additively modifying the price reference or (alternatively) the current price for the value of the quality change.

It is important to note that the hedonic pricing methods are based on the assumption that prices of products in a market are affected by the product offer characteristics. For example, the price of a pair of trousers will depend on the cloth used, the brand, etc. Thus, these methods help estimate the value of a product offer based on consumer willingness to pay for the product offer as and when its characteristics change.

Hedonic methods require relatively large datasets with a wide range of product characteristics. Hedonic methods also require statistical expertise and the application of diagnostic tools to help identify bias risks. Thus an obvious disadvantage of these methods is the cost. Moreover, Member States may have particular technical difficulties in applying hedonic methods.

Hedonic methods offer an acceptable solution for quality adjustment in clothing, provided that it is performed with due competence (properly specified, regularly re-estimated, not adjusting for fashion-related characteristics), although the significant data requirements need due consideration. Hedonics is potentially the best way to deal with the problem of quality change especially in clothing where country practice appears to have proved the approach adequate. Therefore, the use of hedonic methods for quality adjustment in clothing should be classified as an A method, although this ideal may not always be attainable or cost-effective in practice.

Direct comparison method: Article 4(5b)

This method compares prices of the replaced and the replacement product offer without adjustment. Any price change between the replacement and the replaced model is assumed to arise from pure price change and not quality change. In the direct comparison method the value of quality change is assumed or judged to be zero. Accordingly, the method is applicable where quality changes are insignificant or considered so by convention.

Direct comparison for essentially equivalent models, combined with bridged overlap in those cases where a replacement model differs significantly from the replaced model, offers an acceptable alternative if the reference method (hedonics) is not possible and is considered a B method for clothing and footwear.

Bridged overlap: Article 4(5c)

In bridged overlap it is assumed that the price change between a replaced and a replacement model is captured by the price change of a similar product or a group of similar products. In the variant of bridged overlap that seems to be mostly used, the price changes of all the other products in the elementary product group or elementary aggregate are used as a measure of the price change in replacement situations.

Sometimes bridged overlap is used for clothing when a quality change is noted. Quality changes are likely to occur when new garment collections are included in the price collection.

A key question is whether the last observed (reduced) price of the replaced product offer should be imputed or the last observed normal price. If the last observed (reduced) price is used, this may introduce a bias when the seasonal pattern of the other products in the group is different. It is not unlikely that products that are less affected by fashion and that continue to be available are less heavily discounted during sales periods, as a result of which a downward bias is introduced if sales prices are imputed. Another possibility is that some products continue to be available, but gradually become less fashionable, as a result of which their price movement over time stays below the price movement of the latest fashion (seasons) products. If this happens, bridged overlap biases the index downward.

If this method is used, then the last observed normal price should be used to minimise any potential downward bias in the index.

Bridged overlap is sometimes useful but it has pitfalls. This method should be used only in exceptional cases, and only if a directly comparable replacement cannot be made. A problematic point is the dependence on the assumption that price differences at a given time correspond to quality differences, as this is easily severely disturbed by fashion variation. The applicability of this method to clothing and footwear very much depends on how the method is used, and how often it is used. If it is used thoughtfully in a limited number of cases, bridged overlap could be considered an acceptable method, i.e. B method. If bridged overlap is used for the majority of replacements, it must be considered a C method.

12.7.5 Seasonality in clothing and footwear

Many products in clothing and footwear are seasonal. Winter clothes may, for example, be available in shops from August or September up and until February or March, after which they are followed by summer clothes and so on. Clothing products at the beginning of a new season which follow those of the previous season are often very different, e.g. winter coats and dresses follow after summer coats and dresses, making quality judgements between them challenging. Some clothes or shoes may disappear seasonally from some shops, e.g. when ski wear follows after swim wear or boots follow after sandals. Seasonal unavailability does not affect the whole range of clothing articles. For example, jeans, underwear or long-sleeved shirts are usually available throughout the year (see also below).

It may be remarked that the seasonal variation in product availability appears somewhat differently in clothing compared to fresh fruit and vegetables. For the latter categories, the seasonal pattern is more varied among products, while for clothing it is more limited to the difference between spring/summer, and autumn/winter. For clothing in particular, sales periods generally occur at the end of seasons. However, climatic differences, and changes in national retailing practices do affect both the seasonal pattern of sales and the number of seasonal collections introduced during the year. As such it is important that each Member State understands the typical seasonal patterns and retail practices which prevail in their county.

As described in Section 7.1, Regulation No 330/2009 states minimum standards for the treatment of seasonal products in the HICP. Seasonal products are those products that are either not available or their purchased volumes are negligible for certain periods of a year in a typical annual cyclical pattern.

The rules allow for the application of two calculation methods, the *strict annual weights method* and a *class-confined seasonal weights method*. A third possibility is to use product specifications that are loose enough to encompass products for all seasons, e.g. *women's outdoor jackets*, allowing for both summer and winter jackets. Under the latter option, the products in question are technically treated in the same way as non-seasonal products.

Counter-seasonal estimation is one of the two options within the strict annual weights method. It uses only those products that are in season to estimate the price development of products which are out of season. This method is most suitable when the year has two or more clearly defined seasons, for example, where summer products follow after winter products and vice versa and where in each month of the year there are sufficient seasonal products available to base the estimation procedure on. This is a particularly appropriate method for the treatment of seasonal clothing and footwear.

As noted above, the prices of some types of clothing are available all year, e.g. jeans, underwear, socks, baby clothes and sports shoes etc. However, it is generally preferred to use only the prices of those seasonal products that are in-season to estimate the index for out-of-season products and disregard the products that are available all year in the estimation process to get a better estimate for the price movements of out-of-season seasonal products. This helps to improve the comparability with results obtained from using the class-confined seasonal weights method.

According to Regulation No 330/2009, when using a strict annual weights method, the price for the first month of unavailability should be a *typical* price so that subsequent estimations are not biased due to atypical prices, which are often observed for many seasonal products in the last month of their availability. This is particularly true for seasonal clothing and footwear, where at the end of each season unsold products are often *on sale* at heavily discounted prices. To avoid a potential downward bias in the index, the typical price used in the first month of unavailability should relate to the normal or average in-season price. Where end-of-season sales exist, the use of the last observed in-season price for the *typical price* should not be used.

The class-confined seasonal weights method is another way to deal with products that are out-of-season and for which prices cannot be observed. While the total weight for the class is fixed each year, the weights for each month can vary and are set to zero for products that are out-of-season. However, the use of variable weights should not reflect any fluctuations in the monthly consumption patterns of products during their in-season period (see Section 7.1).

12.8 Financial services

12.8.1 Introduction

Financial and banking services include services such as handling of payments, money transfer, foreign currency exchange, stockbrokerage and investment funds. These services often involve fees which can be charged at a flat rate, i.e. a fixed level/charge in all cases, or charges can be proportional to the value of the transaction. Charges for some services like payment handling and stockbrokerage often combine flat and proportional elements, involving a flat minimum charge on small transaction amounts and a proportional charge on larger amounts.

From 2001 the coverage of financial services in the HICP was extended to include not only flat fees but also explicit fees proportional to transaction value. Regulation No 1920/2001 provides general rules for service charges which are proportional to transaction values (see Section 7.3). However, a fundamental restriction is that HICP excludes FISIM (Financial Intermediation Services Indirectly Measured, ECOICOP 12.6.1), which comprises those parts of financial services where the implicit charge involved is the net interest earned by financial institutions. FISIM is excluded because the scope of the HICP is restricted to monetary transactions by Regulation No 2016/792 Article 2(20) — see Sections 2.3.1 and 2.3.3.

The way in which financial services are delivered to consumers varies notably among countries. For example, in some cases transaction (i.e. chequing) accounts are provided free of charge if the account holder maintains a positive

balance in the account. In other countries similar accounts are subject to monthly or annual fees. Even within countries, different financial institutions may adopt either one or both of these approaches. Such complex pricing structures entail difficulties in the design and application of harmonised methodologies for the HICP at the level of financial and banking services sub-indices (ECOICOP 12.6.2). In particular, the borderline between explicit and implicit charges is not always clear-cut. These issues cannot be entirely eliminated but have to be kept in mind when using these indices.

The financial industry is continually evolving with new consumer products being introduced from time to time, including new ways of serving its customers. For example, traditional bank offices serving customers at a counter have largely given way to telephone and internet banking, which can be accessed through smart phones and other devices. In-person banking has partly been moved to non-traditional locations such as supermarket outlets, for operating cost efficiency and customer convenience. Furthermore, the range of options has widened to households for investing their savings, with innovations such as index-linked investment funds. The dynamic nature of the financial services industry needs to be closely monitored by HICP compilers to keep the sample of financial services properly updated and representative of current consumer behaviour.

This section provides practical advice for defining a price and a representative transaction for both flat and proportional fees in the context of financial and banking services, while observing the fixed-basket (Laspeyres) principle on which the HICP is based.

12.8.2 Legal requirements for the HICP

Article 2(2) of Commission Regulation (EC) No 1920/2001 of 28 September 2001 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 as regards minimum standards for the treatment of service charges proportional to transaction values in the Harmonised Index of Consumer Prices amending Commission Regulation (EC) No 2214/96 ([135]) states the following rule:

> *'Where service charges are defined as a proportion of the transaction value, the purchaser prices are defined as the proportion itself, multiplied by the value of a representative unit transaction in the base or reference period.'*

Article 3 of the same regulation states the following rules:

> *'1. The HICP sub-indices concerned shall be calculated using a formula which is consistent with the Laspeyres-type formula used for other sub-indices. They shall reflect the price change on the basis of the changed expenditure of maintaining the consumption pattern of households and the composition of the consumer population in the base or reference period.*
>
> > a) *The purchaser prices of services to be used in the HICP shall be the actual charges levied directly on consumers in exchange for the service provided. The HICP shall include charges expressed as a flat fee or flat rate.*
> >
> > b) *Changes in purchaser prices which reflect changes in the rules determining them shall be shown as price changes in the HICP.*
> >
> > c) *Changes in the purchaser prices resulting from changes in the values of the representative unit transactions shall be shown as price changes in the HICP.*
> >
> > d) *The representative unit transactions shall be expressed in physical terms, except where this is not appropriate or possible, in which case they shall be expressed in the currency of the Member State.*
> >
> > e) *The change in the values of the representative unit transactions may be estimated by the change in a price index which represents appropriately the unit transactions concerned. Where they exist, HICP sub-indices or aggregate indices shall be deemed appropriate for this purpose.*
>
> *2. Where the specification changes, prices shall be treated in accordance with the rules on specification changes, and in particular those regarding quality adjustment as laid down in Article 5 of Regulation (EC) No 1749/96.*
>
> *3. Where services have been made available to consumers free of charge and subsequently an actual price is charged, the change from zero to an actual price, and vice versa, shall be reflected in the HICP.*

([135])   OJ L 261. 29.9.2001, p. 46. and corrigendum published in OJ L 295, 13.11.2001, p. 34.

4. *Where services jointly provided with other goods or services have been made available to consumers free of an explicit charge and subsequently are charged for on a separate basis, the change shall be reflected in the HICP.*

5. *Where relevant, the procedure provided for in Article 5 of Commission Regulation (EC) No 2646/98 concerning tariffs shall apply mutatis mutandis.'*

In accordance with Commission Regulation (EC) No 1749/96 of 9 September 1916 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices, the following ECOICOP categories of financial services are included in the HICP:

12.6 Financial services n.e.c.

    12.6.1 FISIM — *Excluded*

    12.6.2 Other financial services n.e.c.

        12.6.2.1 Charges by banks and post offices

        12.6.2.2 Fees and service charges of brokers, investment counsellors

Excluded

Interest payments and interest-like charges of any kind and administrative charges of private pension funds and the like (Article 4 of Regulation No 1920/2001).

12.8.3 Principles

The following four ([136]) general principles are useful to ensure compliance with the legal requirements of the HICP:

1. Country of recording of credit and debit card fees, etc.

2. Annual resampling

3. Weights

4. Exclusion of FISIM and interest and interest-like charges

12.8.3.1 Principle 1: Country of recording of credit and debit card fees, etc.

The use of credit and debit cards while abroad to purchase goods and services, or to withdraw cash, often attracts explicit fees and charges. The following clarifies as to which economic territory these fees and charges should be recorded.

The fees levied on the use of the card abroad are not part of the price of the good or service purchased as these fees are taken directly from the consumer's bank account or are charged to his or her credit card and are not invoiced by the outlet where the good or service is purchased. The expenditure for the actual good or service purchased should be allocated to the HICP of the Member State where the good is purchased or service is delivered, in accordance with the domestic concept (see Chapter 2). However, as the fees that consumers are charged for using their cards abroad are levied by the service provider (bank or credit card company) in the country of residence, and not in the Member State where the purchase occurred, these charges should be allocated to the country of residence.

Companies providing various goods and services, e.g. for internet purchase (see Section 7.2) sometimes charge a fee for payment by credit or debit card. However, these fees may partly result from costs of the retailer for bank charges which are passed on to the consumer. They should be included in the prices of the goods or services concerned as they are unavoidable charges directly associated to a specific good or service. As such these fees form part of the purchase price of the good or service and are not charges for financial services to consumers.

([136]) Principles 1-3 while having no legal basis are nonetheless useful for ensuring compliance with HICP Regulations. Principle 4 on the exclusion of Financial Services Indirectly Measured, has a legal basis in that Regulation 2016/792 Article 2(20) restricts the coverage of HICP to monetary transactions only.

The representative transactions for using credit and debit cards abroad typically include:

- The service fee charged to the consumer's account for using an automated teller machine (ATM) outside the country of residence to withdraw an amount of local currency equivalent of a given amount in the currency of the consumer's residence, in the price reference period. (e.g. the withdrawal of the amount of USD in using a German credit card currently equivalent in purchasing power to EUR 100 of the preceding December).

- The service fee charged to the consumer's account when purchasing abroad a good or service of a given value in foreign currency expressed in the currency of the consumer's residence, in the price reference period.

The value of the reference transaction (e.g. EUR 100) should be kept constant in real terms by monthly price updating using the all-items HICP of the previous month and an appropriate exchange rate, until the next annual basket update. It should be noted that keeping the real value of the reference transaction constant implies that the value in nominal terms varies (see Section 7.3).

12.8.3.2 Principle 2: Annual resampling

The coverage and internal weights of ECOICOP 12.6.2 should be reviewed and updated annually using the latest available information. Likewise, the reference transactions for proportionally charged financial services should be either completely resampled or as a minimum they should be revalued, i.e. price updated using the all-items HICP (see Section 12.8.7).

12.8.3.3 Principle 3: Weights

The weights for financial services, both for fixed and proportional charges, should reflect the actual charges paid by consumers for obtaining the service, and not any estimated values, such as those obtained from using modelled reference transactions which are required for compiling the index. For example, for stockbrokers, the weight should reflect their observed revenues from consumers in the weight reference period and not an estimated weight based on the reference transactions used to estimate the price index for stockbroking.

Weights at the aggregate level should preferably be derived from national accounts data. Data for use in compiling weights at the detailed level may be obtained from other sources, notably financial service institutions or regulatory agencies (see Section 12.8.8).

12.8.3.4 Principle 4: Exclusion of Financial Intermediation Services Indirectly Measured (FISIM) and interest and interest-like charges

In much of the financial sector, the provision of financial intermediation services does not attract an explicit charge. Instead, revenues from these services, known as Financial Intermediation Services Indirectly Measured (see Section 12.8.1), are derived from the spread between the interest rate charged on loans and that paid out on deposits. As no monetary transaction takes place, Financial Intermediation Services Indirectly Measured is excluded from the HICP (See Regulation No 2016/792 Article 2(20) and Sections 2.3.1 and 2.3.3).

The exclusion of Financial Intermediation Services Indirectly Measured means that some of the intermediation services that customers benefit from are not covered in the HICP. A possible consequence of this convention is that movements in the index (and changes in weights) can occur if providers of financial services change their pricing strategy by shifting away from implicit charges towards charging more of explicit fees (or vice versa).

Additionally, as stated in Article 4 of Regulation No 1920/2001, interest and interest-like charges, although they are monetary transactions, are excluded from the HICP. The reason for this is that these charges do not fall within the scope of the HICP. They are regarded as distribution of primary income (property income) which is receivable according to the property rights of the owners of financial assets and are excluded from the scope of Household Final Monetary Consumption Expenditure (see Section 2.3.1).

12.8.4 Coverage of financial services

The range of products included in ECOICOP 4-dgit Class 12.6.2 — Other financial services n.e.c. are sub-divided into two 5-digit sub-classes:

12.6.2.1 — Charges by banks and post offices, including actual charges by saving banks, money changers and similar financial institutions.

12.6.2.2 — Fees and service charges of brokers, investment counsellors, including charges for financial services of tax consultants and the like.

The services provided by banks, post offices, saving banks, currency exchange offices, and other financial institutions include the following products:

- Cashing of cheques or money orders, money transfers, payments and currency exchange services

- Investment services: investment in various kinds of securities, funds etc.

- Custody services (deposit services)

- Safe-deposit services

- Dealing in precious metals

- Property or assets management

- Consultancy and brokerage

- Management and processing of customer accounts (e.g. book and record keeping)

- Settlement of financial intermediation services and other financial services.

12.8.5 Prices of financial services — flat fees

Some fees for financial services are flat fees. Like most prices, they are stated as a given monetary amount charged for a specified service, not depending on a transaction value. (They are sometimes called *fixed* fees in contrast to proportional fees, see Section 12.8.6, but not to be confused with fixed in the sense of administered.) Examples are fees for deposit services, and fees for opening an account or obtaining a loan. Such flat fees are in principle treated like any prices in the HICP.

One important matter is the treatment of different prices for different customers. In many financial institutions, not all the customers pay the same charges for the same services, depending on pricing policy of the financial institution and the type of account held by the consumer. For example, bank accounts may be free to operate if the consumers deposit a fixed amount of money into their accounts each month, for consumers who do not deposit this minimum amount, fees may be charged for operating the account. Furthermore, new fees can be levied when service providers re-design their fee structures. For example, customers of a bank may have to pay suddenly for cash withdrawals in cash machines not belonging to the bank. In such situations, a problem is obtaining the percentage of transactions affected by the fees, and for this approximations may be needed.

In practice, more or less complex structures of fees occur. For example, loyalty discounts may apply, so that customers with a long record of managing their accounts well automatically qualify for being treated as premium customers, entitled to some services at a reduced price or for free. Bundling may apply, e.g. with a package that includes withdrawals and transfers within stated limits above which additional withdrawals or transfers are charged for separately.

Such complex fee structures can in principle be treated as tariffs, either using the tariff element components involved, or by a consumer profiles approach, as for electricity or telecommunication services (see Sections 7.4 and 12.6), and for bundled services (Section 7.6). The detailed design of the price measurement should be devised pragmatically in view of the complexity of the pricing and the weight in the HICP.

12.8.6 Prices of financial services — charges proportional to the transaction value

Charges proportional to the transaction value, known as ad valorem charges, apply for various financial and banking services, such as payment services, money transfers, foreign currency exchange and stockbrokerage (see also Section 7.3).

Purchaser prices for proportional service charges are defined in Regulation No 1920/2001 Article 2(2), and are obtained from three elements:

1. The *proportion itself* usually expressed as a percentage rate. This is normally readily observable.

2. The *unit transaction value* which is the quantity of the service purchased expressed in monetary terms. For example, the fee paid for exchanging Euros for dollars e.g. purchasing 100 Euro (or national currency) against its equivalent amount of US dollars (or foreign currency) (see under Foreign currency exchange below for details); or providing tax consultancy service for a client with a given annual income. This has to be specified in the price reference period (December of each year) to define the price to be followed. The amount should be representative of typical consumer expenditure in the weight reference period.

3. During the year, the representative unit transaction value (element 2 above) of the price reference period (the preceding December) is to be held constant in real terms. This is in accordance with the principle of a Laspeyres-type (i.e. fixed-basket) index, as described in Article 2(14) of Regulation No 2016/792 (see Chapters 2 and 8). In particular, Article 3(e) of Regulation No 1920/2001 quoted in Section 12.8.2 explains that the change in the values of the representative unit transactions may be estimated by the change in an appropriate price index, normally a sub-index or aggregate index of the HICP.

Price changes will occur for these types of services due to the general rate of inflation, even if the proportional charge in percentage terms remains unchanged. For example, a unit transaction value of 100 euro in the price reference period should be updated so that in the comparison period it retains the purchasing power that 100 euro had in the price reference period.

Thus, the price for the service is the amount paid by the consumer for a transaction (the unit transaction) expressed in value terms (monetary). This is representative of purchases in the weight reference period i.e. the unit transactions should be defined in relation to the size of typical purchases of the service in question. For example, for currency exchange services, a consumer might well purchase US dollars to the value of 500 euro. However, they are unlikely to purchase US dollars to the value of 5 000 euro. Likewise, for investment services, an investment (the unit transaction) of 1 000 Euro may be representative, whereas an investment of 50 euro would not be representative. In addition, any flat charges such as minimum fees, if levied, should also be included in the price of the service purchased.

Article 3(1) of Regulation No 1920/2001 details how proportionally charged services should be treated. Annex 7.3 gives a technical description and sets out the algebra for pricing such charges.

Definition of a unit transaction

The prices of proportionally charged services, in the form of percentage charges, are normally observable from published price lists or collected replies from the service providers or the internet. By contrast, defining the unit transaction is less straightforward. Namely, financial and banking services cover a range of more or less complex products including foreign currency exchange services, the trading of securities (stocks, shares in investment funds, etc.), and other services such as tax consultancy and financial advice. Below are some specific examples of typical unit transactions for common proportionally charged financial services.

As will be described below, the value of the unit transaction should be continually updated during the year. This serves to keep the quality, in the sense of user functionality, of the priced service constant during the year. Namely, the user functionality of the service can be seen as proportional to the value of the transaction, i.e. the monetary amount in real terms that is handled by the service.

Foreign currency exchange

Charging for the purchase of foreign currency may be *explicit,* i.e. with a visibly stated commission fee, or it may be *implicit* i.e. with no visibly stated commission fee charged for the service i.e. commission-free currency exchange. In the latter situation, a commission is implicitly charged by way of the differences between the service provider's selling and buying rates. As there is no visible monetary transaction (for the exchange service itself), commission-free currency exchange is excluded from the HICP (see Principle 4).

Where explicit commission fees are charged (see element 1 above), these are calculated as a proportion (percentage) of the value of the transaction. For example, if the commission rate is 1.80 %, and the *unit transaction* in the price reference period is defined as purchasing the 100 euros worth of US dollars (see element 2 above), then the price to be recorded in the price reference period is 1.80 euro.

Two remarks can be made on this unit transaction. First, the example assumes the perspective of consumers in the euro area. For non-euro area countries the national currency should be used and not the euro. Second, the unit transaction could theoretically have been defined as buying 100 USD for the equivalent amount of euro, rather than buying USD for 100 euro. But the alternative choice would be less practical, as it would involve adjustment for inflation in various countries and currencies.

When the unit transaction is followed over time, it has to be adjusted for both inflation and changes in the exchange rate. This is needed for the exchange service to be comparable over time by retaining its user functionality, which corresponds to the purchasing power of the amount exchanged. For example, in a period of high inflation, not adjusting for inflation would bias the index downward.

Thus the unit transaction (element 3 above) should be adjusted monthly using the relevant exchange rate and the all-items HICP. For the all-items HICP, the number for the preceding month can be used, as that for the current month is not yet available for the index calculation.

It should be noted that in applying these adjustments, the value of the unit transaction in the comparison period may not reflect a real transaction. For example, if inflation from the price reference period has been 1.5 % and there have been no changes in the exchange rate, then the uprated value of the unit transaction in the comparison period would be 101.5 euro. This is clearly not a value that a consumer could actually exchange as generally only notes can be exchanged. However, it should be remembered that the aim is to *model* the price change of the service for a notional transaction of fixed purchasing power, and not the price change of an unadjusted transaction of fixed value. e.g. 100 euro as both inflation and changes in exchange rates will change the purchasing power of the transacted value.

It is also important to bear in mind Principle 2, annual resampling (Section 12.8.3 above); each December the chosen unit transactions should be reviewed as part of the annual resampling exercise to ensure that the values set reflect typical purchases.

For example, suppose that the central bank exchange rate ([137]) is 1.1122 USD for one euro in the price reference period, and 1.1544 USD for one euro in the current (comparison) period. Suppose further that the all-items HICP for the country of residence has changed from 101.23 to 102.45 between the price reference period and the period prior to the current (comparison) period, and that the commission fee then changed from 1.80 % to 1.75 %. The appropriate price relative (or index) for the current period is then calculated as:

$$(1.75/1.80) \times (1.1544 / 1.1122) \times (102.45 / 101.23) = 102.12725.$$

In this calculation, the first factor is the change in commission rate, the second factor adjusts for the change in exchange rate, and the last factor adjusts for the change in HICP for the country of residence. It can be noted here that month-to-month changes in the index are in practice often due to changes in exchange rate and inflation rate of the previous month, rather than to more infrequent changes in the commission rate.

In real world situations, it is normally necessary to specify a larger reference unit transaction than 1 euro. This is because some money exchangers in addition to charging a percentage commission rate also impose a minimum charge. In such situations, care should be taken to define the unit transaction to represent a typical transaction amount, so that changes in the commission rate and in the minimum charge are duly reflected in the index.

([137]) Commission-free exchange rates, as advertised by some currency providers, should not be used, as their advertised rates include an implicit commission/service charge.

Investment funds

Investment funds are subject to the rules of Parliament Regulation (EU) No 1286/2014 on key information documents for packaged retail and insurance-based investment products (PRIIPs). While this is not an HICP regulation, it is relevant as a part of the trading environment for investment products. The providers of such products are obliged to publish a *key information document* (KID) constituting pre-contractual information on costs and various characteristics of the product.

Investment funds often apply an annual management charge (AMC) defined as a given percentage of the current asset value. For example, the charge can have the form that 1.50 % of the asset value is deducted annually from the latter. This charge can be applied either instead of or in addition to charges applied to the buying or selling of fund shares.

In the HICP, the annual management charge proportional to asset value is to be treated as a charge proportional to the transaction value. Funds can be discontinued from time to time, and in the price collection they should then be replaced with similar funds to ensure that they reflect actual price developments.

The unit transaction for annual management charges can be defined as the annual management of shares worth a given amount in monetary terms in the price reference period. The value of the unit transaction is updated by the all-items HICP.

The use of the all-items HICP as updating index is because of the fact that the user functionality of the service deteriorates with inflation, which makes the monetary value of the assets handled less useful to the consumer. The updating with the all-items HICP adjusts for this change in user functionality (see also Section 7.3). A stock price index such as the FTSE 100, DAX or Dow Jones indices etc. should not be used as these do not keep the user functionality of the service constant. Namely, the more the investment is worth, the greater is the user functionality of the service managing it. Also, stock price indices follow asset price values which can be volatile and asset price movements would dominate the modelling of the service charge.

For example, suppose that between the price reference period and the current period a fund with 1.60 % annual management charge was replaced by one deemed essentially equivalent, with 1.50 % annual management charge, while the all-items HICP changed from 101.23 to 102.45. Neither of the two funds levies any other charges than the annual management charge. The price relative for the replacement fund is then calculated as:

$$(1.50/1.60) \times (102.45 / 101.23) = 0.948798.$$

More explicitly the calculation can be stated as follows. Let the unit transaction be specified as the management of €1 000 of asset value in the price reference period. In the price reference period the charge for the unit transaction is then:

$$€1\ 000 \times 1.60 = 1\ 600.$$

In the comparison period, the asset value is updated to:

$$€1\ 000 \times 102.45 / 101.23 = 1\ 012.0517,$$

and the charge is:

$$1\ 012.0517 \times 1.50 = 1\ 518.0775.$$

This results in a price relative of:

$$1\ 600 / 1\ 518.0775 = 0.948798$$

as before.

Stockbrokerage, purchasing or selling of shares, unit trusts or other securities

Stockbrokerage covers the purchasing or selling of shares, unit trusts or other securities. Stockbrokers buy or sell shares or other securities on behalf of their clients. The service provided consists of arranging for a transaction to take place on conditions specified by the client, e.g. a certain block of securities that are being bought or sold. Usually, consumers are charged proportionally to the value of the traded block of securities. The proportional charge is often combined with a minimum charge.

For stockbrokerage and similar services, the representative unit transaction should be the trading of a basket of securities, defined in value (monetary) terms that is representative for such services used by consumers in the price reference period i.e. the December of the previous year. The volume of the representative unit transaction in the price reference period is the amount invested in stocks (i.e. the value of the investment e.g. EUR 1 000) which should be kept constant between annual basket updates.

The all-items HICP should be used for the adjustment of the representative unit transaction values in order to reflect the changes in percentage charges arising from the change in purchasing power of the representative unit transaction through time as a result of inflation. The reasoning behind this is similar to that in the preceding section on investment funds. Stock market or similar price indices should not be used. The price reference period expenditure is therefore held constant in real terms (see also Section 7.3).

Financial advisers and tax consultants

The services of financial advisers, who may charge flat fees, proportional fees or both, should be treated in the same way as stockbrokers. In other words, an investment of a given value in monetary terms is defined for the price reference period, and then the index is updated every period by any change in the fees charged by the advisor for advice on an equivalent value of investments.

Fees for tax or investment consultancy are sometimes determined as a given proportion of the total of the assets that are subject to the consultancy.

The unit transaction can therefore be defined as consultancy concerning a given set of assets, worth a given monetary amount in the price reference period. This set of assets is assumed to be of a given level of complexity from a consultancy view, in terms of diversity, risk etc. The basket of services to be priced consists of the set of consultancy services that are required for this set of assets. The value of the unit transaction is updated by the all-items HICP. The HICP, not stock market or corresponding indices, should be used to maintain the value of the representative unit transaction in the price reference period, so that only changes in the service charge are captured. The reasoning is similar to that for investment funds and stockbrokerage in the preceding sections.

The precise definition of the unit transaction depends on the consultants' pricing strategies. For example, a tax consultant could charge clients in proportion to their taxable income. If so, the unit transaction can be defined as consultancy for a client with a given income level in the price reference period. The value of the unit transaction can then appropriately be updated in relation to the development of average incomes as measured by income statistics. The all-items HICP could be used as a proxy for the latter.

12.8.7 Sampling

Financial and banking services are subject to continual change, with new products entering the market. The ways in which services are paid for can also change, with implicit charges replacing explicit charges and vice versa, as has been the case for currency exchange and some bank account charges. How financial services are delivered can change. For example, cheques have almost disappeared with the increased use of debit cards and online payment services. The number of physical bank branches has declined substantially.

These developments confirm the importance in price index work to monitor financial services markets and to regularly update the samples of providers and of products accordingly. New providers of financial services may appear on the market and rapidly gain significant market share, as supermarket chains and independent banks have done. The coverage of ECOICOP 12.6.2 should be assessed for structural changes to the market and products, preferably annually, to maintain representativity (Principle 2, Section 12.8.3 above).

The first step in establishing a sample frame is to understand the universe of financial service providers — banks, post offices, credit card companies, stockbrokers, financial advisers, accountants, tax consultants, currency exchange offices, etc. — and the potential universe of services (product offers) available. It is also important to take into account the fee structures and pricing strategies for these financial services, as they can vary considerably among countries.

For example, in some countries, the day-to-day operation of bank accounts is free of explicit charges. Nonetheless even these accounts often charge explicit fees for a range of services such as purchases and cash withdrawals abroad, overdraft fees, supply of documents (e.g. replacement statements) and other additional services such as

balance alerts via SMS. Some non-bank providers also operate automated teller machines in convenience stores, bars etc. which attract fees for cash withdrawals. These charges can be flat, proportional or a combination of both.

Table 12.8.1 below gives an overview of types of services that financial intermediaries provide and can be used as a starting point in developing a sampling frame for banking services. Probably not all of the services below attract considerable consumer expenditure everywhere and as such they do not need to be explicitly priced, e.g. opening of accounts, and the exact range of relevant specific services to be priced depends on the fee structures and pricing strategies occurring within each Member State.

As with many other services such as telecommunications, financial institutions often bundle services into packages for which a single monthly fee is applied. Where they do occur, they should be treated in accordance with the guidance given in Section 7.4 — Tariffs and Section 7.6 — Bundles. Particular care is needed when such bundled packages include non-financial services such as for travel insurance or motor vehicle assistance (breakdown) services. The table shows that ECOICOP 12.6.2 covers more than just day-to-day banking.

Table 12.8.1: Types of services provided by financial intermediaries

Types of financial services	Examples/Comments
Bill payment services	Direct debits, standing orders etc.
Stop payment services	Stopping the above
Bank to Bank domestic and abroad	Money transfer services
Transfers, and cash withdrawals	Abroad
Money withdrawal services	Automated teller machines
Issuing and closing accounts	Not often charged for
Borrowing services	Loan arrangement fees etc.
Provision of documents	Duplicate statements etc.
Current and savings bank explicit charges.	Direct banking services
Credit card services	Cash advance fees, overseas transaction fees, overdue payment penalties etc.
Foreign currency transactions	Commissions
Brokerage services	Stockbrokers fees
Safe custody of securities	Storing of documents
Safe custody of valuables	Safe deposit services
Security broking	Securities trading
Fund management services	Unit trust management fees
Cheques	Travellers cheques, Cashing cheques in a bank other than the issuing bank
Financial advisory services	Financial advisers fees & charges
Accountancy and tax advisory Bundled financial services	Tax planning and accountancy Packages with e.g. transfer, management and advisory services

Sampling stages and procedures

When developing a sampling frame it is advisable to first identify those consumption segments that attract significant consumer expenditure, and then to identify the main providers for each consumption segment. If providers of financial intermediation services are numerous, it may be appropriate to use a cut-off sample to identify the most representative ones.

The sampling of specific products for price collection could normally be undertaken by purposive selection (see Chapter 4) of products that apparently attract considerable consumer expenditure. Websites of the sampled service providers can be used as an informal frame for purposively sampling specific products, and providers of these can be asked for supplementary information on actual consumer demand for their products.

Sampling of investment funds from long lists can pragmatically be undertaken by a simple form of probability sampling, such as systematic sampling with a randomly selected starting point and a constant interval between selected elements.

In all countries, the provision of financial and banking services is tightly regulated, often by central banks or other public institutions. Hence these institutions offer a potentially rich data source from which providers and services with large market shares in terms of expenditure can be identified. This could help in developing an adequate sampling frame, although some caution is required, as financial intermediaries supply services to all sectors of the economy, not households exclusively.

When service providers and products have been sampled, it is then necessary to select or define the representative transactions to be priced. This is normally done judgementally by purposive selection. For more complex products, such as investment products, assistance from the sampled service providers or independent financial advisers can be useful so as to ensure representativity.

The fees levied by financial service providers are typically tariffs, with a list of charges for specific transactions e.g. withdrawing money from an automated teller machine, monthly or annual charges for holding an account, charges for balances alerts by SMS, and charges for a replacement statement. As with other tariffs it is not necessary to price every tariff element. The service providers sampled should be able to identify the most important elements (in expenditure terms). Where they are unwilling to do so, a judgement-based approach may be necessary. Guidance on the treatment of tariff prices is given in Section 7.4.

Bundled financial services, e.g. packages including several components such as transfers, savings management, free overseas cash withdrawals and advisory services, should also be sampled in proportion to their relative market shares (see Section 7.6 on bundled products).

12.8.8 Data sources for weights

As with the treatment of other goods and services in the HICP, weights for financial and banking services should relate to actual expenditures by households (resident and non-resident) on the economic territory of the Member State. For flat fees, estimating their weight is generally not problematic. Likewise, for proportionally charged financial and banking services, the weights should reflect actual expenditures that relate to the weight reference period. For example, for foreign currency exchange services, the actual amount of commission paid, and not the value of the estimated unit transactions used in computation of the index, should form the basis of the weights.

For financial services and banking there are generally three possible sources of weights:

1. National accounts;

2. Financial enterprises / Financial regulators;

3. Household budget surveys (HBS).

As discussed below, these sources are often not consistent with each other and can yield different results. In particular, household budget surveys are subject to measurement difficulties in relying on questionnaires to households where the recording of actual expenditures may not always be complete or accurate.

The weights for financial services can vary considerably between countries; this reflects not only the data sources used but also reflects the ways in which services are charged for. For example, in some countries banks do not charge explicit fees for operating an account that is in credit, while in other countries the operation of an account is explicitly charged for.

ECOICOP aggregate weights

For the *aggregate class weight,* the national accounts should be the preferred source of data, as they are derived from data deemed most accurate for estimating total expenditure. Namely, to the extent deemed appropriate, the national accounts use data from both financial enterprises and the household budget survey. However, the national accounts are unlikely to provide sufficient detail for calculating weights at the elementary aggregate level.

Elementary aggregate weights

After the estimation of the class and sub-class weights, elementary aggregate weights need to be estimated and the representative unit transactions chosen. The basic steps to achieve this are the following:

1. Define the relevant elementary aggregates within the ECOICOP sub-class 12.6.2 (e.g. banking services, currency exchange, financial advice etc.),

2. Estimate the weights for each elementary aggregate,

3. Define the representative products for fixed charge services and the unit transactions for proportionally charged services, in each elementary aggregate,

4. Select the most representative service suppliers from which prices should be collected.

The order in which these steps are performed could be modified according to local conditions. For example, it can be useful to select service providers first (step 4), and then using information from the sampled providers, define representative products and unit transactions (step 3), where this is feasible.

For the estimation of elementary aggregate weights, there is some discretion in terms of the data sources that can be used. There are two general approaches:

1. Use of specific data from financial institutions on the kind of services supplied to the household sector, or

2. Use of the household budget survey if it provides sufficient detail so that weights for particular financial services can be estimated.

Data from financial intermediaries (1) should in principle contain a great deal of detail regarding categories of expenditure, though some of this detail may be lost if data are reported to regulators in aggregate form. Another disadvantage is that as financial intermediaries serve all sectors of the economy, the data they provide may include business as well as household expenditures. Regulators may also be able to provide information on the market shares, in terms of revenue, of the major banks etc. which can be useful in constructing appropriate sampling frames and weighting schemes of service providers.

Data from the household budget surveys (2) are generally problematic and likely to suffer from under-reporting of expenditures for financial and banking services, as such expenditures are generally not well captured in household budget survey questionnaires. In various ways under-reporting of expenditures could particularly affect the recorded expenditure of relatively wealthy households, who are likely to use more financial services than less wealthy households, and so, bias the weights. Furthermore, the household budget survey uses the residential concept, and not the domestic concept, which is needed for the HICP (see Chapter 2). This can be a problem, for example, in countries with many overseas visitors, or frequent cross-border shopping trips to or from countries with another currency.

Consequently, the choice of source data for weights can potentially have a large impact on the quality of the weights regarding risks of substantial bias. In particular, the household budget survey has various measurement pitfalls which need careful attention.

To follow the domestic concept (Principle 1), the fees paid by non-resident households for services such as foreign currency exchange should be included in the weights of the Member State where the expenditure occurs. Accordingly, the use of resident-only based surveys such as the household budget survey will not capture all these expenditures leading to an underestimation of the weights. Where household budget surveys are used, these need to be supplemented with data from other sources such as those described above.

12.9 Electronic goods

12.9.1 Introduction

Electronic goods comprise a relatively modest part of Household Final Monetary Consumption Expenditure but nevertheless can have a substantial impact on the overall HICP. This is due to the fast technological development for such goods, which over many years has led to considerable falls in quality-adjusted prices and can be expected to continue to do so in the future.

Electronic goods are not formally defined, but by common consent comprise articles like mobile telephones, audio-visual products, digital cameras, computers and corresponding accessories. A list of the ECOICOP categories which cover most goods of a predominantly electronic character is included in Annex 12.9, although it should be noted that goods containing internal electronic components also occur in several other ECOICOP categories.

The fast technological development of electronic goods has two important implications for the compilation of HICPs. First, product development can result from time to time in the introduction of radically new products, sometimes referred to as revolutionary products, such as smart phones and smart watches, electronic notepads and tablets. Such innovative products have to be identified in a timely fashion as newly significant and introduced into the HICP on a timely basis. Second, from a customer perspective product development can lead to increasingly better performance of existing products, such as computers becoming able to handle ever more advanced software to furnish the needs of games with higher resolution pictures. This evolutionary trend has to be addressed by product replacement in the HICP basket and the application of quality adjustment.

12.9.2 Legal requirements

There are no HICP rules specifically relating to electronic goods, but the treatment of electronic goods in the HICP should comply with all the rules laid down in the HICP Framework Regulation and other regulations, including the comparability criterion ([138]), especially those relating to price observations, target samples and quality adjustment procedures. Abiding by these rules is particularly important for fast-moving hi-tech electronic goods where the scale and pace of technological innovation can be substantial and where non-compliance can cause bias in the respective indices. The same circumstances make it particularly challenging to meet the need to draw and maintain a representative sample in a dynamic universe and to adjust prices for quality change. It is worth noting that the requirement to adjust prices for quality change can be fulfilled by both *explicit* and *implicit* methods of quality adjustment (see Chapter 6 and later sections).

Radically new products — which often occur in electronic goods — are to be treated as newly significant goods and services, according to Article 4 of Regulation No 1749/96. This Regulation requires Member States to systematically seek to identify newly significant goods and services, and check the significance of goods and services reported to be newly significant in other Member States. It is further stated that the HICP shall include the price changes of newly significant goods and services, within 12 months of their identification either by adjusting the weights or by assigning part of an existing weight specifically to the newly significant good or service (see Chapter 3). The choice of approach is dependent on market trends i.e. how the newly significant good or service impacts on consumer expenditure — an issue that is very difficult to determine in a timely manner as early sales can be very volatile and there is generally little expenditure information available on newly introduced products until sometime after the product enters the market.

12.9.3 Sampling

For any given ECOICOP category, the aim is to price a representative sample of product offers within a consumption segment (see Chapter 4), which are resilient to changes in retail practices and to product turnover in the retail

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([138]) Regulation No 2016/792 Article 4(2a): HICPs are deemed comparable if they do not differ systematically by more than one-tenth of one percentage point on average over one year against the preceding year due to their methods of compilation.

market. A newly significant evolutionary product should be categorised in the same consumption segment as the product it replaces, so as to maintain the representation of the consumption segment.

The concept of consumption segments also comes into play in the context of revolutionary products. New consumption segments for revolutionary products should be included in HICP by resampling and not by replacement (see Chapter 4).

Achieving a representative sample is particularly dependent on:

- The procedures for the initial sampling of product offers, which is usually purposive.

- The procedures used for selecting replacements when product models disappear from outlets' shelves or websites.

- The procedures in place to update the sample selection to reflect the turnover in product models in evolutionary products and in the introduction of revolutionary products.

These issues are discussed in a more general context in Chapters 4-6. Electronic goods are prone to high turnover in the models being sold, and the value of the price-determining characteristics can change notably over a short period of time. This is because as the underlying technology improves existing product offers become increasingly out-of-date and therefore the features they offer are less valued by the consumer. This has implications for the application of methods of quality adjustment such as hedonic methods where the price-determining characteristics need to be revalued on a regular basis, in this case by re-estimating the hedonic function (see Chapter 6).

It should also be noted that for electronic goods there can be quality changes in a model which superficially appears to be exactly the same as that priced in the preceding month. This can be the case even where the model number or name has not changed. During price collection the price collector should always check for such cases, for example, by seeing whether the model number or name is suffixed by a different code or letter or whether the product includes a label advertising an additional or improved feature. For instance, a letter 'A' added as a suffix to the model number of a digital camera may indicate that the memory card has increased from 32 to 64 GBs.

Given the dynamics of the retail market, the sampling techniques used to select and maintain a sample of electronic goods are of particular importance in ensuring that the index accurately reflects price movements. Up-to-date sampling frames for probability sampling of electronic goods are rarely readily available, although they can sometimes be constructed using, for example, sales information supplied by a sample of retail outlets, retail chains or trade organisations. However, the application of probability sampling requires an up-to-date sampling frame. Otherwise, the results can be grossly misleading, for example by over-representing models where sales have declined due to rival models entering the market. It is for the above reasons that most statistical offices rely on purposive sampling.

However, traditional sampling and price collection techniques involving visiting outlets to collect prices can be problematic as this may not yield enough prices that have to be matched from one month to the next to provide a reliable sample. The extent to which this can be a problem increases the more the product is narrowly defined.

Online price collection using web-scraping techniques may overcome some of the problems mentioned above, as it has the potential to generate a product sample and the corresponding prices for narrowly defined products such as a particular brand and model number of an electronic good (see Section 5.5.2).

It should be noted that internet outlets can be very prominent for electronic goods, and this needs to be recognised when sampling outlets and products e.g. by identifying a separate strata for internet purchases.

Maintenance of the sample of electronic goods can especially benefit from a regular and more rigorous and frequent review process than for other parts of the HICP basket. This can be informed by benchmarking the product offers in the achieved sample and the prices collected in outlets with, for example, sales data collated by market research companies or data collected directly from retail outlets by the Member State, for example as part of a retail enquiry undertaken for other purposes. The latter data can provide useful quality checks on the achieved sample. Depending on the characteristics of the data sources and local circumstances, the same data can also be used for probability sampling. A systematic analysis of the prices dataset and feedback from price collectors can also prove instructive and may indicate the need for a re-drawing of the sample.

Differences in price trends between electronic products that have been in the market for some time and corresponding more up-to-date products that have been introduced more recently demonstrate the importance of

providing for diversity in the selection of product offers within elementary aggregates. Diversity in selection should help to ensure that, even with apparently homogeneous product groups, the resulting sub-index is representative and free, for instance, from the downward bias that can arise from over-sampling out-of-date product offers whose prices may fall significantly and relatively quickly as the result of sales.

Research has indicated that replacement selection by price collectors can involve a risk of loss of diversity in the sample if price collectors tend to be conservative in their choices of brands or variants e.g. by always selecting a certain brand even if the sales of the latter are in decline. Because of this there is a strong case for head office to be proactive in the sample selection of electronic goods and to include this aspect in the instruction to and training of price collectors and to be more prescriptive in the instructions given to price collectors. For example, the introduction of some form of probability sampling or quota sampling, based on sales data, may act as a useful control for representativity in cases where price collectors are given generic price descriptions and asked to select the most representative product variety in the shop being visited. Such a control would, for instance, provide a mechanism for ensuring better representation of different brands. Alternatively, head office could determine the product descriptions, with the price collector playing no part in the selection of items for pricing.

The extent to which a sample remains representative is highly dependent on the rules used for product replacements (see Chapters 4 and 5). It is recommended that when traditional price collection methods involving visits to physical outlets are used for electronic goods, the product replacement strategy should follow the principle of selecting the currently *most representative* (most sold) product offer. Compared with the option of replacement with the *most similar* product, replacement with the most representative product offer has the benefit of maintaining the up-to-datedness of the sample with respect to product characteristics. However, the increase in non-comparable replacements that will arise will necessitate more quality adjustment and the imputation of prices so that the index becomes more dependent on effective quality adjustment.

When the choice of a replacement product offer is made by a price collector, the choice of replacement should ideally be reviewed by commodity experts at head office. They should use expert knowledge of the market and benchmark information, such as any available sales data, to test whether the product offers being priced are representative of current purchases. This could be done via occasional studies to assess the suitability of the sample.

12.9.4 Newly significant goods

From time to time radically new kinds of products appear on the market, products that are not even by quality adjustment equivalent or comparable to existing products. Electronic goods typically dominate newly significant products. Such radically innovative kinds of products are typically used in ways that differ from the use of existing products, and thus they may be considered as forming new consumption segments (see earlier references and Chapter 4). These radically new products are to be treated as newly significant goods and services (see Section 12.9.2).

When a product with thoroughly new technology first appears on the market, such as digital cameras when they first appeared, it can happen that at the start the product has high prices, small sales volumes and basic features. But then the situation changes quickly, with rapid price falls, growing sales volumes and improved quality including better components and new features.

It is not self-evident how much of the initial price fall should ideally be reflected in the HICP, when it affects relatively limited sales volumes. That is, should the price collection for the product preferably start as soon as possible i.e. the December after the product is first identified, or should this rather wait until the product has become more established? (Perhaps in the December of the following year?) This is a matter of judgement. Guidance cannot be prescriptive as the most appropriate course of action depends on the circumstances and characteristics of the market place and, most particularly, on the volume of sales and whether the price being charged is relatively stable and denotes market equilibrium. A middle way is that Member States monitor the market situation continuously and are ready to start price collection for the product in the December after it has been established that the product is representative enough of consumer purchases i.e. achieves a significant volume of sales and the price has settled to reflect a market equilibrium. The detection of price movements will probably be a matter of comparison with other electronic products plus the change in price of the newly significant product over a certain period of time using various sources of information including, possibly, sales data provided by businesses. To repeat, some element of judgement is needed in deciding when to introduce a newly significant good into the HICP.

There is a converse issue concerning when electronic goods with previously new technology should be dropped from price collection. For example, with compact digital cameras, prices and volumes have fallen due to the presence of smart phones. Similarly with CDs and DVDs which have been overtaken by the onset of streaming services and smart TVs. However, this issue is not generally problematic, as such goods can be replaced as part of the usual annual resampling procedures.

12.9.5 Recommended quality adjustment methods

12.9.5.1 The inter-relationship with replacement sampling

For electronic products, quality adjustment has to be done with care in view of the substantial quality changes that are commonplace with electronic products. Implicit methods such as bridged overlap and monthly chaining and replenishment (MCR) can be expected to work adequately, provided that equilibrium disruptions from discounts are given due consideration and bias is not introduced into the index. Chapter 6 discusses these issues in more depth.

As hinted above, quality adjustment methods should be considered in the context of sampling and sample maintenance. For example, when purposive sampling is deployed to select product offers for pricing, there are compelling reasons to refrain from the convenience of selecting product offers that are not likely to change in subsequent periods, in order to reduce the incidence of quality change and the need for quality adjustment. Namely, a purposive sampling strategy aimed at minimising the incidence of quality change can compromise the representativity of the sample. This has the potential to introduce sample bias particularly with electronic goods where there is a high rate of technological innovation. Therefore, clear and precise rules for the drawing of an initial sample and for the replacement of product offers are important, especially in a dynamic market such as that for electronic goods.

It is important to choose outlets which are relevant for the particular electronic good. In the case of electronic goods it is likely that the market is highly competitive and very transparent as consumers can use the internet for price comparisons as well as for purchasing products. Central price collection may therefore be suitable at least for some electronic goods such as computers. It may be necessary to distinguish between large and small retailers and between online purchases and purchases in physical outlets, all of which need to be covered.

Given the rapid technological change in electronic goods, replacing models is a relatively frequent task. When a model is judged to be no longer representative, for example, due to a marked deterioration in sales and the increasing sales of competitors' products, as shown by transaction data, it should be replaced, even if it is still available albeit with very low sales (see Chapters 4, 5 and 6).

Note the particular importance of keeping the outlet sample representative of where customers purchase electronic goods, including online which has grown significantly in importance.

12.9.5.2 Quality adjustment methods — overview

The accuracy of the quality adjustment techniques deployed is especially important with an increase in the amount of quality adjustment being applied. For electronic goods, the amount of quality adjustment and its influence on the affected sub-index, as indicated by implicit quality indices (IQIs, see Chapter 6) can be considerable, so quality adjustment procedures have to be chosen and applied rigorously and with care.

As described in Chapter 6, there are various *implicit* and *explicit* methods for determining the difference in monetary value associated with a quality change. For electronic goods the standard implicit method of bridged overlap can be useful but there is a risk of bias in the index when prices are falling at the same time as quality is improving. This is because the method assumes that the pure price change between the replaced and replacement product is the same as that for similar product offers. The validity of this assumption can be questionable. The problem is that for electronic goods significant price changes frequently occur at the time newly arrived models are launched and retailers discount the preceding models to clear stock. Therefore, using the price changes of the preceding models to impute the price changes for newly introduced ones can systematically result in an incorrect estimate of the true price change for the newly introduced models and cause a bias in the price index. Thus, if the prices of old models show little price change or an actual decline due to reduced demand and over-supply, using the old models to impute the price change for new ones will underestimate the true price change of the new model and cause a downward bias in the index. It is important to try to overcome this problem by using, where possible, comparable

models in the bridged overlap, although such models can be difficult to identify and may be small in number. The exclusion of sale prices in the imputation can also help, as this quite probably indicates ageing models about to be withdrawn from the market place.

The use of comparable models in the bridged overlap is sometimes referred to as the class mean imputation method as opposed to the overall mean imputation method. The imputed price change uses only the price changes of comparable products, the imputation being limited to those models that have exactly the same price-determining characteristics, or products with replacements that have been declared comparable after review or have already been quality-adjusted through one of the explicit methods.

Monthly chaining and replenishment (MCR) is another option, which is similar to the bridged overlap method. Each month-to-month index shows the change in the index from one month to the next. The sample is then updated in subsequent monthly comparisons. The chained monthly indices (unweighted Jevons, Dutot) link together these month-to-month changes by successive multiplication. Monthly chaining has the advantage of maintaining representativity when there are a high proportion of models leaving or entering the market each month, which can often be the case with some types of electronic goods such as computers. Monthly chaining using the Carli formula (the average of price relatives), which is generally not allowed by regulation, should be avoided due to its potential to produce perverse results generated by the effects of price bounce [139]. The Dutot and Jevons indices, the two elementary aggregate formulas laid down in HICP regulations, do not suffer from this problem (see Chapter 8).

Of the explicit methods, option pricing — where retail list prices for components can give the marginal cost of adding an option separately — is primarily used where the prices of components can be found, such as for computers, but can be problematic to apply in practice because of the inter-relationship between the different features of electronic goods. For example, a change in the processor of a computer is often linked to changes to other components of the computer such as the motherboard. Furthermore, the price for fitting options separately may not reflect consumer willingness to pay for standard features corresponding to the options.

Another option is supported judgement, where experts give evidence-based market valuations of changes in product specifications. This is reliant on the expertise and objectivity of the judges and is best avoided. However, it may be suitable for highly complex products where alternative methods are not feasible or fail. It is advisable when adopting this approach to draw on the expertise of more than one expert. Clear guidance should be given on what the experts are being asked to estimate i.e. a market valuation from a consumer perspective of the quality difference resulting from a change in specification, that is, how the latter affects the consumer perception of the product.

The use of hedonics for quality adjustment is discussed in the following sections. It should be noted that in the case of major changes in quality, hedonic quality adjustment is difficult to apply since the replaced and the replacement products are in principle not comparable at all, thus compromising the ability to compute a common hedonic function which reflects the value of price-determining attributes in both products. When major quality changes occur, bridged overlap is best applied. The price development of all other models of the same consumption segment which were not replaced build the bridge between the replaced and the replacement model. In this way the average price development of a set of comparable models is used.

12.9.5.3 Hedonic regression

A hedonic regression equation relates the price of a product model to its characteristics — see Chapter 6 and, for more detailed explanation, the Handbook on Hedonic Price Indexes by Triplett [140]. Also the ILO Consumer price index manual: Theory and practice [141]. Hedonic methods have been proved useful for quality adjusting some electronic goods but there are a number of downsides. Hedonic methods require comprehensive and up-to-date data on product characteristics, such as can be obtained from attribute files for scanner data and from electronic product catalogues. Hedonic methods also require statistical expertise and the application of diagnostic tools to help identify serious bias risks. For example, inter-dependency between different product characteristics, resulting from the bundling of characteristics referred to above, can lead to multicollinearity and imprecise results. This is the case for smart phones where specifications are highly collinear — premium smart phones will have all high

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[139] The phenomenon known as price bounce is when, as in the case of the Carli formula, in certain circumstances, and most particularly when prices oscillate, chain-linking of within-year indices introduces an upward bias in the overall price index. The Jevons and Dutot formulas are not susceptible to any bias due to price bounce. See Consumer Price Index Manual: Theory and Practice, paragraphs 20.60 - 20.61.

[140] Triplett, J. (2006), Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products, Paris: OECD Publishing.

[141] ILO/IMF/OECD/UNECE/Eurostat/World Bank: Consumer price index manual: Theory and practice, Geneva: International Labour Office, 2004.

specifications and entry level smart phones will have all low specifications — this leads to everything being correlated — e.g. ram, processor speed, camera megapixels, screen resolution etc. are all high for flagship phones and all low for cheaper phones. In addition, there are judgements to be made in the application of hedonics, such as the choice of the functional form of the model, the issue of weights in the regression and the particular hedonic method used e.g. the time-dummy approach or the imputed price index method. There remain a number of unresolved issues or, at the very least issues which generate discussion and involve choices being made ([142]).

A crucial step in the estimation process is the selection of quality variables in the regression equation. These variables should be carefully selected to be such that they express product characteristics that essentially matter to consumers. Examples are the screen size of a TV set, and the storage capacity of a computer. Particular challenges arise when applying hedonics to electronic goods where the characteristics of the models can change significantly over a short period of time leading to the hedonic function rapidly becoming out-of-date and over-estimating the value of those price-determining characteristics that are not new and ignoring the market value of new characteristics.

If hedonics is used it is recommended that systematic procedures are put in place to ensure that the hedonic function is regularly updated prior to it becoming out-of-date and causing bias in the index and, conversely, to avoid resources being used for unnecessarily updating the hedonic regression each month.

In principle, two aspects come into play in formulating a decision rule on whether the hedonic model should be updated.

1. The extent to which the predicted price analysis falls outside pre-determined confidence intervals of the estimated predicted price — intervals that can be approximated for complex sample designs.

2. The impact on the index and the All-Items HICP of any bias from performing quality adjustment with an out-of-date hedonic function.

The index compiler should also be proactive in updating the hedonic model by re-running it when new features enter the market to pre-empt when the model might get out-of-date.

Hedonics are considered by some to be the ideal quality adjustment method if data and resources are available. But in practice other methods of quality adjustment are more common, reflecting in part the practical challenges of undertaking hedonic methods in practice, and also the fact that hedonic methods do not necessarily generate superior accuracy in adjustment for quality change.

Access to large data sets provides the opportunity to apply methods that work similarly to hedonics without having to observe all the characteristics of the products. For instance, automated web-scraping of online data gives the potential for timely and high-frequency price measurement.

It should be noted that for some types of electrical goods, e.g. digital cameras, the expenditure weight within an HICP may be so low that hedonics may not be a cost-efficient solution and implicit methods can be adequate. Depending on country conditions, for other goods such as smart phones, the cost of handsets are often included as a non-identifiable part of a mobile call plan. As such the weight for independently purchased phones can be very low. In these circumstances care should be taken to evaluate the cost of the quality adjustment method used against the likely impact on the index.

Evaluating the motivation for the hedonic approach

Given the resource and data issues involved in the use of hedonic methods for quality adjustment, the technique should normally only be seriously considered where there are significant changes in quality (but not where there changes are so major that the two models are not comparable at all — see earlier section) or where the bridged overlap implicit method is likely to be unsatisfactory such as when prices are falling and quality is improving. Even for electronic goods, not all products have a high enough turnover of models and price-determining characteristics to warrant the use of hedonics. The situation can, in any case, rapidly change according to the market evolution of the product concerned and with the appearance of other competing products.

([142]) Erwin Diewert, (2003), 'Hedonic Regressions: A Review of Some Unresolved Issues'.

The identification of product categories that would benefit from hedonic quality adjustment is not straightforward. For example, the use of Implicit Quality Indices to identify quality change (see Chapter 6) is not helpful, as they do not reflect the actual quality change in the market, but rather the adjustment for quality change made in the index.

Another indicator for assessing the need for hedonic quality adjustment is to examine the turnover of models and the rate of technological change. The turnover rate can be measured, either directly from HICP data or from scanner data, by measuring the proportion of the sample being replaced each month or the amount of turnover in the market i.e. the proportion of models leaving plus the proportion of models entering the market. The rate of change in quality can be derived from scanner data attribute files. In this case the practical way forward is to track the proportional change in the value of numerically measurable variables, or to track the changes in the proportions containing desirable attributes.

12.9.5.4 Bridged overlap

Implicit methods of quality adjustment, particularly bridged overlap, are generally useful for electronic goods, as effective competition makes price differences informative of quality differences. However, care must be taken as discounts on out-of-date models can cause an imbalance between supply and demand and thus lead to price differences that sometimes do not reflect quality differences as such, with the result that the index can suffer from bias (see Section 12.9.5.2 and Chapter 6).

12.9.5.5 Evaluation of quality adjustment methods

Some methods of quality adjustment can tend to be less robust in the compilation of indices for electronic goods due to the high turnover of models and the magnitude of change in the technical features. But this depends on the state of the market — most particularly the pace of technological change — and this should be tested.

With option pricing, the pace at which new technological features are introduced in electronic goods can often mean that a list price for a new feature will not have been published and a shadow option price will be impossible or at best difficult to obtain from the retailer or manufacturer.

Monthly chaining and replenishment (MCR) is a practical variant of bridged overlap and, in principle, is also suitable for electronic goods. But again care has to be taken regarding old or discontinued models being sold at stock-clearance discounts: however this is a problem that can normally be overcome by replacing product offers in the sample as and when new models appear on the market and before preceding models are discontinued. Price bounce is an issue if the Carli formula is used (see earlier references).

The alternative methods of estimating the value of quality differences and the basic procedures associated with carrying out these methods are described and evaluated in some detail for some specific products in the CENEX HICP Quality Adjustment Handbook [143]. Explicit methods, such as hedonic methods, serve to identify a monetary value of the quality difference between a replacement product and its predecessor. This value can then be removed from the directly observed price difference between the two subsequent products. What remains is the pure price change which should finally enter the index calculation. The CENEX Handbook also indicated that hedonic re-pricing was more suitable than bridged overlap for desktop computers, whereas both methods yield similar results for notebooks. Furthermore, the empirical studies in the Handbook showed some difficulties regarding the application of 100 % option pricing for both desktop and notebook computers. These conclusions, however, cannot necessarily be generalised and may change with time given the rapidly changing markets involved.

A tentative conclusion to be drawn from these studies is that some experimentation should be undertaken on a case-by-case basis to identify the most appropriate method of quality adjustment for an electronic good, taking into account the validity of the results, the availability of data and the operational demands of each method.

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[143] CENEX: Handbook on the Application of Quality Adjustment Methods in the Harmonised Index of Consumer Prices. Statistisches Bundesamt, Germany. 2009.

Annex 12.9: ECOICOP categories consisting of goods of a predominantly electronic character

08.2 Telephone and telefax equipment

    08.2.0 Telephone and telefax equipment

        08.2.0.1 Fixed telephone equipment

        08.2.0.2 Mobile telephone equipment

        08.2.0.3 Other equipment of telephone and telefax equipment

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09.1 Audio-visual, photographic and information processing equipment

    09.1.1 Equipment for the reception, recording and reproduction of sound and picture

        09.1.1.1 Equipment for the reception, recording and reproduction of sound

        09.1.1.2 Equipment for the reception, recording and reproduction of sound and vision

        09.1.1.3 Portable sound and vision devices

        09.1.1.9 Other equipment for the reception, recording and reproduction of sound and picture

    09.1.2 Photographic and cinematographic equipment and optical instruments

        09.1.2.1 Cameras

        09.1.2.2 Accessories for photographic and cinematographic equipment

        09.1.2.3 Optical instruments

    09.1.3 Information processing equipment

        09.1.3.1 Personal computers

        09.1.3.2 Accessories for information processing equipment

        09.1.3.4 Calculators and other information processing equipment

    09.1.4 Recording media

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        12.3.1.2 Clocks and watches

Annex I: European classification of individual consumption according to purpose – ECOICOP

01	FOOD AND NON-ALCOHOLIC BEVERAGES
01.1	**Food**
01.1.1	Bread and cereals
01.1.1.1	Rice
01.1.1.2	Flours and other cereals
01.1.1.3	Bread
01.1.1.4	Other bakery products
01.1.1.5	Pizza and quiche
01.1.1.6	Pasta products and couscous
01.1.1.7	Breakfast cereals
01.1.1.8	Other cereal products
01.1.2	Meat
01.1.2.1	Beef and veal
01.1.2.2	Pork
01.1.2.3	Lamb and goat
01.1.2.4	Poultry
01.1.2.5	Other meats
01.1.2.6	Edible offal
01.1.2.7	Dried, salted or smoked meat
01.1.2.8	Other meat preparations
01.1.3	Fish and seafood
01.1.3.1	Fresh or chilled fish
01.1.3.2	Frozen fish
01.1.3.3	Fresh or chilled seafood
01.1.3.4	Frozen seafood
01.1.3.5	Dried, smoked or salted fish and seafood
01.1.3.6	Other preserved or processed fish and seafood-based preparations
01.1.4	Milk, cheese and eggs
01.1.4.1	Fresh whole milk
01.1.4.2	Fresh low fat milk
01.1.4.3	Preserved milk
01.1.4.4	Yoghurt
01.1.4.5	Cheese and curd
01.1.4.6	Other milk products
01.1.4.7	Eggs
01.1.5	Oils and fats
01.1.5.1	Butter
01.1.5.2	Margarine and other vegetable fats
01.1.5.3	Olive oil
01.1.5.4	Other edible oils
01.1.5.5	Other edible animal fats

01.1.6	Fruit
01.1.6.1	Fresh or chilled fruit
01.1.6.2	Frozen fruit
01.1.6.3	Dried fruit and nuts
01.1.6.4	Preserved fruit and fruit-based products
01.1.7	Vegetables
01.1.7.1	Fresh or chilled vegetables other than potatoes and other tubers
01.1.7.2	Frozen vegetables other than potatoes and other tubers
01.1.7.3	Dried vegetables, other preserved or processed vegetables
01.1.7.4	Potatoes
01.1.7.5	Crisps
01.1.7.6	Other tubers and products of tuber vegetables
01.1.8	Sugar, jam, honey, chocolate and confectionery
01.1.8.1	Sugar
01.1.8.2	Jams, marmalades and honey
01.1.8.3	Chocolate
01.1.8.4	Confectionery products
01.1.8.5	Edible ices and ice cream
01.1.8.6	Artificial sugar substitutes
01.1.9	Food products n.e.c.
01.1.9.1	Sauces, condiments
01.1.9.2	Salt, spices and culinary herbs
01.1.9.3	Baby food
01.1.9.4	Ready-made meals
01.1.9.9	Other food products n.e.c.
01.2	**Non-alcoholic beverages**
01.2.1	Coffee, tea and cocoa
01.2.1.1	Coffee
01.2.1.2	Tea
01.2.1.3	Cocoa and powdered chocolate
01.2.2	Mineral waters, soft drinks, fruit and vegetable juices
01.2.2.1	Mineral or spring waters
01.2.2.2	Soft drinks
01.2.2.3	Fruit and vegetable juices
02	**ALCOHOLIC BEVERAGES, TOBACCO AND NARCOTICS**
02.1	**Alcoholic beverages**
02.1.1	Spirits
02.1.1.1	Spirits and liqueurs
02.1.1.2	Alcoholic soft drinks
02.1.2	Wine
02.1.2.1	Wine from grapes
02.1.2.2	Wine from other fruits
02.1.2.3	Fortified wines
02.1.2.4	Wine-based drinks
02.1.3	Beer

02.1.3.1	Lager beer
02.1.3.2	Other alcoholic beer
02.1.3.3	Low and non-alcoholic beer
02.1.3.4	Beer-based drinks
02.2	**Tobacco**
02.2.0	Tobacco
02.2.0.1	Cigarettes
02.2.0.2	Cigars
02.2.0.3	Other tobacco products
02.3	**Narcotics**
02.3.0	Narcotics
02.3.0.0	Narcotics
03	**CLOTHING AND FOOTWEAR**
03.1	**Clothing**
03.1.1	Clothing materials
03.1.1.0	Clothing materials
03.1.2	Garments
03.1.2.1	Garments for men
03.1.2.2	Garments for women
03.1.2.3	Garments for infants (0 to 2 years) and children (3 to 13 years)
03.1.3	Other articles of clothing and clothing accessories
03.1.3.1	Other articles of clothing
03.1.3.2	Clothing accessories
03.1.4	Cleaning, repair and hire of clothing
03.1.4.1	Cleaning of clothing
03.1.4.2	Repair and hire of clothing
03.2	**Footwear**
03.2.1	Shoes and other footwear
03.2.1.1	Footwear for men
03.2.1.2	Footwear for women
03.2.1.3	Footwear for infants and children
03.2.2	Repair and hire of footwear
03.2.2.0	Repair and hire of footwear
04	**HOUSING, WATER, ELECTRICITY, GAS AND OTHER FUELS**
04.1	**Actual rentals for housing**
04.1.1	Actual rentals paid by tenants
04.1.1.0	Actual rentals paid by tenants
04.1.2	Other actual rentals
04.1.2.1	Actual rentals paid by tenants for secondary residences
04.1.2.2	Garage rentals and other rentals paid by tenants
04.2	**Imputed rentals for housing**
04.2.1	Imputed rentals of owner-occupiers
04.2.1.0	Imputed rentals of owner-occupiers
04.2.2	Other imputed rentals
04.2.2.0	Other imputed rentals

04.3	**Maintenance and repair of the dwelling**
04.3.1	Materials for the maintenance and repair of the dwelling
04.3.1.0	Materials for the maintenance and repair of the dwelling
04.3.2	Services for the maintenance and repair of the dwelling
04.3.2.1	Services of plumbers
04.3.2.2	Services of electricians
04.3.2.3	Maintenance services for heating systems
04.3.2.4	Services of painters
04.3.2.5	Services of carpenters
04.3.2.9	Other services for maintenance and repair of the dwelling
04.4	**Water supply and miscellaneous services relating to the dwelling**
04.4.1	Water supply
04.4.1.0	Water supply
04.4.2	Refuse collection
04.4.2.0	Refuse collection
04.4.3	Sewage collection
04.4.3.0	Sewage collection
04.4.4	Other services relating to the dwelling n.e.c.
04.4.4.1	Maintenance charges in multi-occupied buildings
04.4.4.2	Security services
04.4.4.9	Other services related to dwelling
04.5	**Electricity, gas and other fuels**
04.5.1	Electricity
04.5.1.0	Electricity
04.5.2	Gas
04.5.2.1	Natural gas and town gas
04.5.2.2	Liquefied hydrocarbons (butane, propane, etc.)
04.5.3	Liquid fuels
04.5.3.0	Liquid fuels
04.5.4	Solid fuels
04.5.4.1	Coal
04.5.4.9	Other solid fuels
04.5.5	Heat energy
04.5.5.0	Heat energy
05	**FURNISHINGS, HOUSEHOLD EQUIPMENT AND ROUTINE HOUSEHOLD MAINTENANCE**
05.1	**Furniture and furnishings, carpets and other floor coverings**
05.1.1	Furniture and furnishings
05.1.1.1	Household furniture
05.1.1.2	Garden furniture
05.1.1.3	Lighting equipment
05.1.1.9	Other furniture and furnishings
05.1.2	Carpets and other floor coverings
05.1.2.1	Carpets and rugs
05.1.2.2	Other floor coverings
05.1.2.3	Services of laying of fitted carpets and floor coverings

05.1.3	Repair of furniture, furnishings and floor coverings
05.1.3.0	Repair of furniture, furnishings and floor coverings
05.2	**Household textiles**
05.2.0	Household textiles
05.2.0.1	Furnishing fabrics and curtains
05.2.0.2	Bed linen
05.2.0.3	Table linen and bathroom linen
05.2.0.4	Repair of household textiles
05.2.0.9	Other household textiles
05.3	**Household appliances**
05.3.1	Major household appliances whether electric or not
05.3.1.1	Refrigerators, freezers and fridge-freezers
05.3.1.2	Clothes washing machines, clothes drying machines and dish washing machines
05.3.1.3	Cookers
05.3.1.4	Heaters, air conditioners
05.3.1.5	Cleaning equipment
05.3.1.9	Other major household appliances
05.3.2	Small electric household appliances
05.3.2.1	Food processing appliances
05.3.2.2	Coffee machines, tea makers and similar appliances
05.3.2.3	Irons
05.3.2.4	Toasters and grills
05.3.2.9	Other small electric household appliances
05.3.3	Repair of household appliances
05.3.3.0	Repair of household appliances
05.4	**Glassware, tableware and household utensils**
05.4.0	Glassware, tableware and household utensils
05.4.0.1	Glassware, crystal-ware, ceramic ware and chinaware
05.4.0.2	Cutlery, flatware and silverware
05.4.0.3	Non-electric kitchen utensils and articles
05.4.0.4	Repair of glassware, tableware and household utensils
05.5	**Tools and equipment for house and garden**
05.5.1	Major tools and equipment
05.5.1.1	Motorised major tools and equipment
05.5.1.2	Repair, leasing and rental of major tools and equipment
05.5.2	Small tools and miscellaneous accessories
05.5.2.1	Non-motorised small tools
05.5.2.2	Miscellaneous small tool accessories
05.5.2.3	Repair of non-motorised small tools and miscellaneous accessories
05.6	**Goods and services for routine household maintenance**
05.6.1	Non-durable household goods
05.6.1.1	Cleaning and maintenance products
05.6.1.2	Other non-durable small household articles
05.6.2	Domestic services and household services
05.6.2.1	Domestic services by paid staff

05.6.2.2	Cleaning services
05.6.2.3	Hire of furniture and furnishings
05.6.2.9	Other domestic services and household services
06	**HEALTH**
06.1	**Medical products, appliances and equipment**
06.1.1	Pharmaceutical products
06.1.1.0	Pharmaceutical products
06.1.2	Other medical products
06.1.2.1	Pregnancy tests and mechanical contraceptive devices
06.1.2.9	Other medical products n.e.c.
06.1.3	Therapeutic appliances and equipment
06.1.3.1	Corrective eye-glasses and contact lenses
06.1.3.2	Hearing aids
06.1.3.3	Repair of therapeutic appliances and equipment
06.1.3.9	Other therapeutic appliances and equipment
06.2	**Out-patient services**
06.2.1	Medical services
06.2.1.1	General practice
06.2.1.2	Specialist practice
06.2.2	Dental services
06.2.2.0	Dental services
06.2.3	Paramedical services
06.2.3.1	Services of medical analysis laboratories and X-ray centres
06.2.3.2	Thermal-baths, corrective-gymnastic therapy, ambulance services and hire of therapeutic equipment
06.2.3.9	Other paramedical services
06.3	**Hospital services**
06.3.0	Hospital services
06.3.0.0	Hospital services
07	**TRANSPORT**
07.1	**Purchase of vehicles**
07.1.1	Motor cars
07.1.1.1	New motor cars
07.1.1.2	Second-hand motor cars
07.1.2	Motor cycles
07.1.2.0	Motor cycles
07.1.3	Bicycles
07.1.3.0	Bicycles
07.1.4	Animal drawn vehicles
07.1.4.0	Animal drawn vehicles
07.2	**Operation of personal transport equipment**
07.2.1	Spare parts and accessories for personal transport equipment
07.2.1.1	Tyres
07.2.1.2	Spare parts for personal transport equipment
07.2.1.3	Accessories for personal transport equipment
07.2.2	Fuels and lubricants for personal transport equipment

07.2.2.1	Diesel	
07.2.2.2	Petrol	
07.2.2.3	Other fuels for personal transport equipment	
07.2.2.4	Lubricants	
07.2.3	Maintenance and repair of personal transport equipment	
07.2.3.0	Maintenance and repair of personal transport equipment	
07.2.4	Other services in respect of personal transport equipment	
07.2.4.1	Hire of garages, parking spaces and personal transport equipment	
07.2.4.2	Toll facilities and parking meters	
07.2.4.3	Driving lessons, tests, licences and road worthiness tests	
07.3	**Transport services**	
07.3.1	Passenger transport by railway	
07.3.1.1	Passenger transport by train	
07.3.1.2	Passenger transport by underground and tram	
07.3.2	Passenger transport by road	
07.3.2.1	Passenger transport by bus and coach	
07.3.2.2	Passenger transport by taxi and hired car with driver	
07.3.3	Passenger transport by air	
07.3.3.1	Domestic flights	
07.3.3.2	International flights	
07.3.4	Passenger transport by sea and inland waterway	
07.3.4.1	Passenger transport by sea	
07.3.4.2	Passenger transport by inland waterway	
07.3.5	Combined passenger transport	
07.3.5.0	Combined passenger transport	
07.3.6	Other purchased transport services	
07.3.6.1	Funicular, cable-car and chair-lift transport	
07.3.6.2	Removal and storage services	
07.3.6.9	Other purchased transport services n.e.c.	
08	**COMMUNICATION**	
08.1	**Postal services**	
08.1.0	Postal services	
08.1.0.1	Letter handling services	
08.1.0.9	Other postal services	
08.2	**Telephone and telefax equipment**	
08.2.0	Telephone and telefax equipment	
08.2.0.1	Fixed telephone equipment	
08.2.0.2	Mobile telephone equipment	
08.2.0.3	Other equipment of telephone and telefax equipment	
08.2.0.4	Repair of telephone or telefax equipment	
08.3	**Telephone and telefax services**	
08.3.0	Telephone and telefax services	
08.3.0.1	Wired telephone services	
08.3.0.2	Wireless telephone services	
08.3.0.3	Internet access provision services	

08.3.0.4	Bundled telecommunication services
08.3.0.5	Other information transmission services
09	**RECREATION AND CULTURE**
09.1	**Audiovisual, photographic and information processing equipment**
09.1.1	Equipment for the reception, recording and reproduction of sound and picture
09.1.1.1	Equipment for the reception, recording and reproduction of sound
09.1.1.2	Equipment for the reception, recording and reproduction of sound and vision
09.1.1.3	Portable sound and vision devices
09.1.1.9	Other equipment for the reception, recording and reproduction of sound and picture
09.1.2	Photographic and cinematographic equipment and optical instruments
09.1.2.1	Cameras
09.1.2.2	Accessories for photographic and cinematographic equipment
09.1.2.3	Optical instruments
09.1.3	Information processing equipment
09.1.3.1	Personal computers
09.1.3.2	Accessories for information processing equipment
09.1.3.3	Software
09.1.3.4	Calculators and other information processing equipment
09.1.4	Recording media
09.1.4.1	Pre-recorded recording media
09.1.4.2	Unrecorded recording media
09.1.4.9	Other recording media
09.1.5	Repair of audiovisual, photographic and information processing equipment
09.1.5.0	Repair of audiovisual, photographic and information processing equipment
09.2	**Other major durables for recreation and culture**
09.2.1	Major durables for outdoor recreation
09.2.1.1	Camper vans, caravans and trailers
09.2.1.2	Aeroplanes, microlight aircraft, gliders, hang-gliders and hot-air balloons
09.2.1.3	Boats, outboard motors and fitting out of boats
09.2.1.4	Horses, ponies and accessories
09.2.1.5	Major items for games and sport
09.2.2	Musical instruments and major durables for indoor recreation
09.2.2.1	Musical instruments
09.2.2.2	Major durables for indoor recreation
09.2.3	Maintenance and repair of other major durables for recreation and culture
09.2.3.0	Maintenance and repair of other major durables for recreation and culture
09.3	**Other recreational items and equipment, gardens and pets**
09.3.1	Games, toys and hobbies
09.3.1.1	Games and hobbies
09.3.1.2	Toys and celebration articles
09.3.2	Equipment for sport, camping and open-air recreation
09.3.2.1	Equipment for sport
09.3.2.2	Equipment for camping and open-air recreation
09.3.2.3	Repair of equipment for sport, camping and open-air recreation
09.3.3	Gardens, plants and flowers

09.3.3.1	Garden products	
09.3.3.2	Plants and flowers	
09.3.4	Pets and related products	
09.3.4.1	Purchase of pets	
09.3.4.2	Products for pets	
09.3.5	Veterinary and other services for pets	
09.3.5.0	Veterinary and other services for pets	
09.4	**Recreational and cultural services**	
09.4.1	Recreational and sporting services	
09.4.1.1	Recreational and sporting services — Attendance	
09.4.1.2	Recreational and sporting services — Participation	
09.4.2	Cultural services	
09.4.2.1	Cinemas, theatres, concerts	
09.4.2.2	Museums, libraries, zoological gardens	
09.4.2.3	Television and radio licence fees, subscriptions	
09.4.2.4	Hire of equipment and accessories for culture	
09.4.2.5	Photographic services	
09.4.2.9	Other cultural services	
09.4.3	Games of chance	
09.4.3.0	Games of chance	
09.5	**Newspapers, books and stationery**	
09.5.1	Books	
09.5.1.1	Fiction books	
09.5.1.2	Educational text books	
09.5.1.3	Other non-fiction books	
09.5.1.4	Binding services and E-book downloads	
09.5.2	Newspapers and periodicals	
09.5.2.1	Newspapers	
09.5.2.2	Magazines and periodicals	
09.5.3	Miscellaneous printed matter	
09.5.3.0	Miscellaneous printed matter	
09.5.4	Stationery and drawing materials	
09.5.4.1	Paper products	
09.5.4.9	Other stationery and drawing materials	
09.6	**Package holidays**	
09.6.0	Package holidays	
09.6.0.1	Package domestic holidays	
09.6.0.2	Package international holidays	
10	**EDUCATION**	
10.1	**Pre-primary and primary education**	
10.1.0	Pre-primary and primary education	
10.1.0.1	Pre-primary education (ISCED-97 level 0)	
10.1.0.2	Primary education (ISCED-97 level 1)	
10.2	**Secondary education**	
10.2.0	Secondary education	

10.2.0.0	Secondary education
10.3	**Post-secondary non-tertiary education**
10.3.0	Post-secondary non-tertiary education
10.3.0.0	Post-secondary non-tertiary education (ISCED-97 level 4)
10.4	**Tertiary education**
10.4.0	Tertiary education
10.4.0.0	Tertiary education
10.5	**Education not definable by level**
10.5.0	Education not definable by level
10.5.0.0	Education not definable by level
11	**RESTAURANTS AND HOTELS**
11.1	**Catering services**
11.1.1	Restaurants, cafés and the like
11.1.1.1	Restaurants, cafés and dancing establishments
11.1.1.2	Fast food and take away food services
11.1.2	Canteens
11.1.2.0	Canteens
11.2	**Accommodation services**
11.2.0	Accommodation services
11.2.0.1	Hotels, motels, inns and similar accommodation services
11.2.0.2	Holiday centres, camping sites, youth hostels and similar accommodation services
11.2.0.3	Accommodation services of other establishments
12	**MISCELLANEOUS GOODS AND SERVICES**
12.1	**Personal care**
12.1.1	Hairdressing salons and personal grooming establishments
12.1.1.1	Hairdressing for men and children
12.1.1.2	Hairdressing for women
12.1.1.3	Personal grooming treatments
12.1.2	Electric appliances for personal care
12.1.2.1	Electric appliances for personal care
12.1.2.2	Repair of electric appliances for personal care
12.1.3	Other appliances, articles and products for personal care
12.1.3.1	Non-electrical appliances
12.1.3.2	Articles for personal hygiene and wellness, esoteric products and beauty products
12.2	**Prostitution**
12.2.0	Prostitution
12.2.0.0	Prostitution
12.3	**Personal effects n.e.c.**
12.3.1	Jewellery, clocks and watches
12.3.1.1	Jewellery
12.3.1.2	Clocks and watches
12.3.1.3	Repair of jewellery, clocks and watches
12.3.2	Other personal effects
12.3.2.1	Travel goods
12.3.2.2	Articles for babies

12.3.2.3	Repair of other personal effects
12.3.2.9	Other personal effects n.e.c.
12.4	**Social protection**
12.4.0	Social protection
12.4.0.1	Child care services
12.4.0.2	Retirement homes for elderly persons and residences for disabled persons
12.4.0.3	Services to maintain people in their private homes
12.4.0.4	Counselling
12.5	**Insurance**
12.5.1	Life insurance
12.5.1.0	Life insurance
12.5.2	Insurance connected with the dwelling
12.5.2.0	Insurance connected with the dwelling
12.5.3	Insurance connected with health
12.5.3.1	Public insurance connected with health
12.5.3.2	Private insurance connected with health
12.5.4	Insurance connected with transport
12.5.4.1	Motor vehicle insurance
12.5.4.2	Travel insurance
12.5.5	Other insurance
12.5.5.0	Other insurance
12.6	**Financial services n.e.c.**
12.6.1	FISIM
12.6.1.0	FISIM
12.6.2	Other financial services n.e.c.
12.6.2.1	Charges by banks and post offices
12.6.2.2	Fees and service charges of brokers, investment counsellors
12.7	**Other services n.e.c.**
12.7.0	Other services n.e.c.
12.7.0.1	Administrative fees
12.7.0.2	Legal services and accountancy
12.7.0.3	Funeral services
12.7.0.4	Other fees and services

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Harmonised Index
of Consumer Prices (HICP)
Methodological Manual

The Harmonised Index of Consumer Prices (HICP) Methodological Manual represents a comprehensive overview of methods that are used in the compilation process for the HICP. The HICP provides the official measure of consumer price inflation in the euro area and the EU. The manual intends to be a practical guide to all steps necessary to produce an HICP and is thus useful for statisticians who are new to the field of price statistics and statistical offices aiming to set up a similar inflation measure. Users of the HICP, such as businesses, policy-makers and researchers may also find this manual useful to help them understand and interpret HICP data. Subjects covered include the HICP concepts, sampling and price collection procedures, methods for quality adjustment, index calculation and many other.

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