

**HANDBOOK
ON
PRICE AND VOLUME MEASURES
IN
NATIONAL ACCOUNTS**

Eurostat

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PREFACE

Economic and Monetary Union and the common currency require good macro-economic statistics. In particular, the Stability and Growth Pact, agreed by the Member States in 1997, created a renewed demand for higher quality and more comparable data on economic growth.

To meet this demand, Eurostat has been working with the Member States to develop improved methods and procedures for the measurement of prices and volumes in the national accounts. In 1998, a Commission Decision was adopted that provided the first step in this process. Much more work on various challenging areas has been undertaken since then by numerous Task Forces of national experts.

This work was brought together in the Handbook on Price and Volume Measures in National Accounts and published in 2001. Since then there has been a considerable discussion on aspects of measuring volume growth in the national accounts, and given the publication of an update of ESA 95 to a new European standard for national accounts, ESA 2010, it was decided to carry out an update of the handbook. The areas where the most significant changes have been made are non-market production, and production of Research and Development services. The coding system has been updated to reflect NACE Rev. 2 and the associated CPA published in 2008.

This handbook provides a complete discussion of the issues involved in measuring prices and volumes, from the general principles to the deflation of individual goods and services. It is fully consistent with the principles of the European System of Accounts 2010, and is intended to elaborate that framework. It also includes a brief chapter on issues of price and volume measurement in the quarterly accounts. Further detail can be found in the Handbook on Quarterly National Accounts¹.

The handbook is precise in its recommendations: it classifies methods into good methods, less good but acceptable methods and methods that are to be avoided. The handbook thereby provides a very useful tool for Member States, candidate countries and other countries to develop the price and volume measures in their national accounts in a harmonised way.

¹ See

http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-GQ-13-004

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1. Introduction

1.1. Background and aim of this handbook

Economic and monetary policy of the European Union (EU) is increasingly integrated. This requires higher and higher standards of national accounts data as a solid foundation for the formulation and monitoring of economic policy. Key players such as the Council, the European Commission and the European Central Bank need in particular high quality and comparable data on price developments and economic growth. Within the EU, national accounts data are also increasingly important for more administrative purposes such as the determination of countries' contributions to the EU budget, assessment of economic convergence, regional funds, etc.

This broad international use of national accounts data has led to an extensive set of international definitions and guidelines, necessary to ensure the reliability and comparability of data. These definitions and guidelines are contained in the System of National Accounts, 2008 (2008 SNA) for worldwide application and the European System of Accounts, 2010 (ESA 2010), which is the EU version. Besides that, a lot of more practical work has been done on the harmonisation of GNI data for the purpose of the Member States' EU budget contributions.

Most of the harmonisation work of national accounts has focussed on current price data, such as the level of GNI. 2008 SNA and ESA 2010 each contain one relatively short chapter on price and volume measures, while in fact the volume growth of GDP is one of the most utilised figures of the national accounts. In the area of price statistics, the work on harmonising the Consumer Price Indices within the EU, resulting in the 'Harmonised Index of Consumer Prices', has been proceeding for a number of years.

Renewed demand for more harmonised national accounts price and volume data came when the European Council in July 1997, agreed on the so-called "Stability and Growth Pact"². In this political instrument for ensuring the stability of the Euro, the Member States commit themselves to keep their government deficits below 3% of GDP. Only in cases of severe recessions, countries may have a higher deficit. A severe recession is defined by the Pact as "an annual fall in real GDP of at least 2%". "Real GDP" must be understood here as the growth of the volume of GDP, not the purchasing power of GDP (see section 1.2). This was the first time that growth data were used for administrative purposes, and this stimulated the work that led to this handbook.

The handbook came about following a program that started in 1997. A Task Force "Volume Measures" showed at that time that the comparability of price and volume data in the EU could be improved. It discussed the issues of the choice of index formula and base year and the adjustments for quality changes. In both

² Official Journal L 209 of 2.8.1997,p. 6 and Official Journal C 236 of 2.8.1997, p.1.

cases, it concluded that differences in choices made by different countries could lead to significant differences in growth rates.

The Task Force also noted that the ever increasing importance of the service sector in the economy, for which price and volume measures are underdeveloped, can seriously hamper the reliability and comparability of GDP growth rates. The economy becomes more and more "intangible", so that it becomes increasingly difficult to apply the traditional price and volume concepts. This is evidenced for example by the difficulties in measuring the impact of the growth of investment in computers and software or research and development.

It was concluded that the existing guidance given by the international standards was not sufficient to guarantee harmonised price and volume data. Therefore Eurostat initiated a work program to provide further guidance. The first step was a Commission Decision, based on the work done by the Task Force that defined the framework for the further work on price and volume measures.

Commission Decision 98/715³ (in this handbook referred to simply as the Commission Decision) specified three main principles that price and volume measurement should follow (see section 2.2 of this handbook). Furthermore, it introduced the A/B/C classification for methods, defining - broadly, see section 1.4 for more precise definitions - which are good (A), which are acceptable (B) and which are unacceptable (C) methods. The Decision specifies A, B and C methods for a number of products, but not for all.

Those products for which no classification could be given were referred to a research program that was to be concluded by the end of 2000. The research program consisted of in total 10 Task Forces, consisting of participants from those Member States known to have particular expertise in that area plus Eurostat and the OECD, on the following topics:

Health services, education services, public administration, construction, large equipment, computers and software, financial intermediation services, real estate, renting and other business services, post and telecommunication services.

Information on best practices outside the EU was also used extensively. Each Task Force produced a final report, including recommendations on A, B and C methods that was presented to the National Accounts Working Group (NAWG). Besides those Task Forces, various topics were discussed at the NAWG, such as changes in inventories and exports and imports.

This handbook is the culmination of the research program that was established by the Commission Decision. It integrates the Commission Decision with the conclusions and recommendations of the Task Forces, and extends on them by discussing those issues that were not the topic of a Task Force or NAWG discussion. It formulates A, B and C methods for all relevant transaction categories

³ Official Journal of the European Communities, 16 December 1998, L 340, p. 33

of ESA 2010 and for all products of CPA. It reflects the work of an additional task force on prices and volumes, meeting in 2011 and 2012, which considered the treatment of quality adjustment in the measurement of non-market output. ESA 2010 rules out the use of quality adjustments to direct output measures, beyond the quality effects incorporated in the use of quantity indicators at as detailed level of homogeneous activities as possible.

- It is the aim of this handbook to provide detailed guidelines for price and volume measures which are consistent with ESA 2010; and
- both theoretically sound and practically useful for improving existing methods, incorporating best practice from within the EU and from other experienced countries;

This handbook is of course not the final word on price and volume measures in national accounts; it does not pretend to have all the answers to the difficulties that national accountants are confronted with. Work on implementing, reviewing and improving the methods described here will continue.

1.2. Scope of this handbook

Price and volume measurement relates to the decomposition of transaction values in current prices into their price and volume components. In principle, the price components should include changes arising solely from price changes, while all other changes (relating to quantity, quality and compositional changes) should be included in the volume components. The aim is to analyse which changes in aggregates are due to price movements, and which to volume changes.

Due to its background related to the Stability and Growth Pact, as outlined in section 1.1, the focus of this handbook is on the measurement of the volume growth of GDP, i.e. intertemporal price and volume measurement. There are however other uses of price and volume data, for example interspatial comparisons, where price and volume levels between countries are analysed. To a large extent the same issues are relevant for intertemporal and interspatial measures, but there are differences too (see 2008 SNA, par. 15.198 and further). This handbook will not discuss interspatial price and volume measures.

Nor will it discuss application to the measurement of purchasing power of income flows, where values are divided by price indices related to some selected basket of goods and services. There can be many choices of the basket of goods and services to use as the deflator in these circumstances and the choice depends on the use to be made of the result. The results are often referred to as "real" values.

The objective and process to be followed when deriving "real" measures are fundamentally different from those used when deflating goods and services to produce volume measures. The main purpose of this handbook is to describe the methods suitable for price and volume measurement in the national accounts rather than the estimation of "real" measures.

Therefore, it is preferable not to refer to the volume measure of GDP as "real GDP" as this may suggest deflation of GDP by some general price indices not

necessarily that of GDP itself. This handbook will speak either of the (growth of the) volume of GDP or of GDP at previous year's prices.

1.3. The distinction between price, volume, quantity and quality

The nature of estimates at previous year's prices is different from that of estimates at current prices in some fundamental respects. Current price accounts can be considered as the aggregation, within an accounting framework, of transactions that took place and can be evidenced. However, volume accounts describe an economic situation of a particular year in the prices of the previous year. In reality, the transactions of the current year would not take place in an identical manner at the prices of the previous year.

The price of a product is defined as the value of one unit of that product. This price will vary directly with the size of the unit of quantity selected. For a single homogeneous product, the value of a transaction (v) is equal to the price per unit of quantity (p) multiplied by the number of units of quantity (q), that is:

$$v = p \times q.$$

Quantities of different products cannot however be aggregated without a certain weighting mechanism. For aggregate products, the term volume is used instead of quantity. Price and volume measures have to be constructed for each aggregate of transactions in products within the accounts so that:

$$\text{value index} = \text{price index} \times \text{volume index}$$

This means that each and every change in the value of a given flow must be attributed either to a change in price or to a change in volume or to a combination of the two.

In principle, the price component should include only changes in price. Price changes for a given transaction flow can occur only as a result of changes in price for individual products. All other changes should be reflected in changes in volumes.

In the economy, most products are available in several varieties of differing quality, each with its own price. Products of different quality are sufficiently different to each other to make them readily distinguishable from an economic point of view. However, they are similar enough to be described by the same generic term. For example, potatoes can be of different varieties (new or old) and available in different states of preparation (washed, unwashed, pre-packed, loose). These can be considered as different qualities of the potato product. Whilst physical characteristics are perhaps the most readily identifiable measure of different qualities they are not the only one. Differences in quality can also be reflected by deliveries in different locations or at different times of the day or at different periods of the year. Differences in the conditions of sale, the circumstances or the environment in which the goods or services are supplied are also aspects of quality.

Changes in quality over time need to be recorded as changes in volume and not as changes in price. Compositional changes in a transaction flow, resulting from a shift from or to higher quality products, need also to be recorded as changes in volume. Similarly, shifts between markets with different prices should also be recorded as changes in volume, provided the different prices are not the result of price discrimination.

The volume index can therefore in principle be broken down into the following three components:

- Changes due to changes in the quantity of the products,
- Changes due to changes in the characteristics of the products, and
- Changes due to compositional changes in an aggregate.

In section 2.4 the problem of quality changes will be discussed in more detail.

1.4. The A/B/C classification

This handbook describes possible methods that can be used for the estimation of prices and volumes. Once described, they are classified according to their suitability. The Commission Decision divides methods into three groups, as follows:

A methods: most appropriate methods;

B methods: those methods which can be used in case an A method cannot be applied; and

C methods: those methods which shall not be used.

The same classification will be used throughout this handbook. A methods are the methods that approximate the ideal as closely as possible. B methods are acceptable alternatives: they are further away from the ideal but still provide an acceptable approximation. C methods are too far away from the ideal to be acceptable. They would generate too great a bias or would simply measure the wrong thing. In some cases, where it is not clear what the ideal would be, it may not be possible to define A methods.

The A/B/C classification is aimed at improvement of current practice. It sets out in what direction improvements can be made. It is therefore important that the criteria for distinguishing A, B and C methods are absolute criteria, i.e. that they do not depend on the present availability of data. In this way, it becomes clear where the biggest problems exist in terms of missing data. It also makes clear how far current practice is away from good practice. It may well be that in some cases A methods are difficult to attain in practice.

The classification of methods can differ from product to product. What is considered a good method for one product can be a less good, or even

unacceptable, method for another. For example, the use of unit value indices can only be accepted if the products to be deflated are homogeneous.

There can be several A or B methods for one product. Institutional differences between countries may lead to different data sources being available and therefore different applicable methods. The results of the methods can nevertheless be comparable. The A/B/C classification shows which methods are considered to give comparable results. It gives the framework for a harmonised approach to improvement of reliability and comparability of price and volume data in national accounts.

1.5. How to read this handbook

The handbook is structured following a "top-down" approach:

- Chapter 2 discusses the issues that concern *all transaction categories and all products*, e.g. the fact that quality changes should be taken into account.
- Chapter 3 discusses the issues that concern *specific transaction categories*, e.g. the valuation of output, intermediate consumption, final consumption, etc.
- Chapter 4 goes into still more detail by focussing on those issues that concern price and volume measurement of the output of *specific products*.

These chapters concentrate on estimate for the annual national accounts. Finally, chapter 5 describes the application of the recommendations of the earlier chapters to the quarterly accounts. The updated Handbook on Quarterly National Accounts [add link] provides detailed guidance on the compilation of quarterly national accounts, including a chapter on volume estimates.

This structure, combined with extensive cross-referencing, avoids repetition of issues. The principles described in chapters 2 apply to all transaction categories and products described in chapters 3 and 4. Chapter 4, as said above, focusses on *output* by product. For guidance on the measurement of e.g. gross fixed capital formation of a particular product, the recommendations of chapters 3 and 4 should be combined.

The handbook does not repeat the 2008 SNA, ESA 2010 or the Commission Decision, but attempts to integrate those texts. At various points, the reader is referred to those texts for more discussion. At the same time, the handbook is much more detailed, in particular in the recommendations on individual products.

It is however not very detailed on specific practical issues related for example to price index compilation. Three other manuals deal with such issues in great detail:

- the manual on Producer Price Indices prepared by the IMF⁴,

⁴ See <http://www.imf.org/external/pubs/ft/ppi/2010/manual/ppi.pdf> for current drafts.

- the Eurostat-OECD Methodological Guide for Developing Producer Price Indices for Services, and
- the manual on Consumer Price Indices prepared by the ILO⁵.

In addition, the Manual of Supply, Use and Input-Output Tables (http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-07-013) contains a chapter on supply and use tables at constant prices. The focus of the Input-Output Handbook is on the specific input-output aspects, the focus of this handbook is on aspects relating to the price/volume decomposition.

Finally, another useful source is the OECD implementation manual for an index of services which contains guidelines and methodologies to measure short-term production activities of the services sector (http://www.oecd-ilibrary.org/economics/compilation-manual-for-an-index-of-services-production_9789264034440-en).

⁵ See <http://www.ilo.org/public/english/bureau/stat/guides/cpi/>

2. A/B/C methods for general procedures

2.1. The use of an integrated approach

2.1.1. An accounting approach to volume estimations

One of the central features of national accounts is the systems approach: all transactions taking place in the economy are recorded in a consistent and systematic way, by making use of accounting rules. A simple rule is for example that total supply (domestic production and imports) and total use (domestic uses and exports) should be equal for each product. Another rule is that total output of an industry should equal its inputs (intermediate consumption plus value added) (see below for further discussion).

The accounting constraints are used to integrate data from a large variety of basic sources, to ensure their consistency and completeness, and in the end to present one unique picture of the economy. Although GDP in current prices can be approached from the output side, the expenditure side or the income side, in the end there is only one GDP, which should be established by balancing the data from the three approaches.

In volume terms, direct measurement of GDP can be obtained only from the output and expenditure sides. The income approach cannot be used to measure GDP volume, since one of its components, the operating surplus, cannot be measured directly in volume terms. Following the output approach, GDP at market prices is equal to

Output at basic prices
 -/- intermediate consumption at purchasers' prices
 + sum of taxes minus subsidies on products.

Following the expenditure approach, GDP can be obtained as:

Final consumption expenditure by households
 + final consumption expenditure by government
 + final consumption expenditure by NPISH
 + gross fixed capital formation
 + changes in inventories
 + acquisitions less disposals of valuables
 + exports of goods and services
 -/- imports of goods and services.

It is important to compile one unique measure of GDP volume growth. Although one may argue whether or not conceptually differences may exist between GDP volume from the output and expenditure approaches, in practice it would be highly undesirable to publish two different GDP growth rates.

Compiling one unique measure of GDP volume requires full consistency between the concepts of price and volume used within the output approach and the expenditure approach. For example, adjustments for quality change of products should be made in the same way on both sides of the accounts.

In many countries, the measurement of GDP volume growth is currently based heavily on only one of the two approaches. This can be either the output or the expenditure approach, depending on the strengths and weaknesses of the data sources in a particular country, which can be very different from other countries. That does not only depend on the quality of the price and volume information, but also on that of the current price data.

In some countries, for example, data on intermediate consumption are scarce, so that the double deflation approach (see section 3.4) becomes unreliable, making the balance swing towards the expenditure approach. In other countries, data on, for example, household consumption expenditure might be regarded as less reliable than output data, so that generally the output approach is preferred.

It can however also be that for one particular product output data are more reliable and for another product the expenditure data. Therefore, in general, the best result will be obtained when the best of both approaches are combined. This can be achieved by using the same accounting framework as used in current prices.

To measure GDP volume, it suffices to breakdown the flows covered by the Supply and Use Table framework in price and volume components. Indeed, the Supply and Use Table system is an excellent framework through which price and volume measures can be established in a consistent and systematic way.

The Supply and Use Table framework (see Chapter 9 of ESA 2010) is based on two accounting constraints, already touched upon above:

- Per product: output + imports = intermediate consumption + final consumption expenditure + gross capital formation + exports
- Per industry: output = intermediate consumption + gross value added.

In chapter 4 of this handbook the appropriate methods for each product are described. This product approach is chosen because prices and volumes are first of all observed for products. Each element of the first constraint should be deflated with an appropriate price index, and the resulting volumes can then be compared to evaluate the reliability of the results. If one would limit oneself to this constraint, it would not be necessary to breakdown output and intermediate consumption of a product by industry.

Output of an industry is obtained by summing the outputs of the various primary and secondary products produced by that industry. The same is true for intermediate consumption of an industry. An important check on the results of this first step can be achieved by applying the second constraint as well. For that step, it is necessary to make the breakdowns by industry. Then, for each industry,

the double deflation procedure can be carried out to estimate gross value added at previous year's prices. In this procedure, the volume trends of intermediate consumption, value added and output can be checked on plausibility.

Without applying the second constraint, intermediate consumption by product often becomes a residual item. It is not possible to verify the plausibility of an estimate of total intermediate consumption of a product, without checking it against the output of the main industries that use that product (in current as well as in previous year's prices). Hence, for a full balancing procedure both accounting constraints have to be applied, i.e. the full Supply and Use Table system has to be filled. Generally, the more detail used in the supply and use tables, the better the results of the balancing procedure will be (see also section 2.2.1)

Balancing volume data in a Supply and Use Table framework requires the use of Laspeyres volume and Paasche price indices. When Fisher price and volume indices were used, it would not be possible to calculate volumes that could be used for balancing, because the volume estimates are by definition non-additive (see section 2.2.3 for more discussion).

Using the accounting framework also permits the calculation of balancing items, such as value added and GDP, at previous year's prices, in the same way as they are calculated at current prices. While balancing items do not have underlying price and volume concepts, by calculating them as a residual at previous year's prices it is nevertheless possible to indirectly derive price and volume components (see section 3.4).

It should be noted that the ESA 2010 transmission program (Annex B)⁶ requires the EU Member States to compile supply and use tables at previous year's prices on an annual basis from reporting year 2015 onwards until end of 2018 at the latest.

2.1.2. Advantage of balancing volume data

The advantage of balancing volume data is the ability to ensure the consistency of the various estimates. For example:

- Per product: price indices collected from different sources (e.g. PPIs, CPIs, export and import prices) for the same product can be compared and checked for plausibility. E.g. a large difference between the price change of household consumption and that of domestic production is difficult to explain in cases where households consume a large share of domestic production (unless a major tax or subsidy change has occurred).
- Per industry: the volume changes of intermediate consumption, value added and output can be compared and checked on plausibility. E.g.: a large deviation between the volume growth of output of steel and the volume growth of the

⁶ http://epp.eurostat.ec.europa.eu/portal/page/portal/esa_2010/key_legal_documents

input of iron ore may indicate problems with the reliability of the price or volume information used.

- In some cases, for one particular element of the supply table, one can collect data on the price change and the volume change, as well as the change in value. The product of the price and volume change should be equal to the change in value.

Most countries currently compile the volume data after the compilation of the current price data. The volume data are in this way somewhat subordinate to the current price data. It can happen that in the process of checking and balancing the volume data, errors are discovered in the current price data. If it is no longer possible to change current price data, then the errors will have to be absorbed by adjusting the growth rates and deflators.

More generally, the price and volume information underlying current price data can help to obtain a better picture of the reliability of the current price data. By not only analysing changes in values but also the changes in prices or volumes, more validation of the basic sources can be done. The preferred procedure would therefore be to balance current and previous year price data simultaneously, i.e. in one and the same process. In that way the possibilities that an accounting framework offers are used to the maximum.

The essential element of simultaneous balancing is that current price estimates are still open to revision when compiling volume estimates. This could also be obtained with an iterative procedure, in which the first step is the balancing of current price data, then the balancing of previous year's prices leading to adjustments to the current prices, which then have to be balanced again leading probably to adjustments in previous year price data, etc. until it converges to a final solution. Such a procedure seems however to be more complicated than simultaneous balancing in which value, price and volume information is integrated in one step.

Simultaneous balancing can also be resource demanding, certainly in an introduction phase. However, it might well lead to efficiencies in the longer term, since the same group of people can carry out the current and volume calculations.

Much more detail on simultaneous balancing and how it can work in practice can be found in the Eurostat Manual of Supply, Use and Input-Output Tables.

2.1.3. Valuation problems

One practical problem that has to be overcome when balancing volume data is the difference in valuation between the supply and use sides. As is well known, data on the supply side are valued at basic prices, while data on uses are valued at purchasers' prices. Therefore, as elaborated in chapters 3 and 4, output is preferably deflated by a PPI at basic prices, while household consumption is deflated by a CPI at purchasers' prices. This presents the problem of how to compare price indices that have a different valuation.

The issue is explained by means of the following example of a homogeneous product that is only consumed by households.

	Output	Trade Margin	Taxes on Products	Household Consumption
Value T	305	60	130	495
<i>Price index</i>	<i>111</i>		<i>118</i>	<i>113</i>
Volume T (prices T-1)	275		110	440
<i>Volume index</i>	<i>110</i>		<i>110</i>	<i>110</i>
Value T-1	250	50	100	400

The observed price index for household consumption is 113, while for output only 111 is registered. This yields volume indices for both sides of 110. The quantity (or volume) change of output and consumption must be the same since there is just one homogeneous product (without quality change) and no users other than households. (In general, with aggregate products and various uses there will of course be different volume growth rates.) In the example, the difference in the price indices must come from changes in the tax rates and margin rates.

For taxes on products, the volume index must equal the volume of the underlying product flow (see section 3.10 for further discussion). It follows that the tax rate increased by 18%. This has to be checked against actual data on tax rate changes.

The great unknown in the example is the volume of trade margins. Section 4.7.1 presents an extensive discussion on the deflation of trade margins. The ideal approach presented in that section is to calculate the volume of trade margins as the difference between deflated sales and deflated purchases. In the example, the volume would be calculated as $440 - 110 \cdot 275 = 55$. The volume index of trade becomes equal to 110, i.e. the same change as output and consumption, implying that the quality of the trade service covered by this margin has not changed.

	Output	Trade Margin	Taxes on Products	Household Consumption
Value T	305	60	130	495
<i>Price index</i>	<i>111</i>	<i>109</i>	<i>118</i>	<i>113</i>
Volume T (prices T-1)	275	55	110	440
<i>Volume index</i>	<i>110</i>	<i>110</i>	<i>110</i>	<i>110</i>
Value T-1	250	50	100	400

In practice, a slightly more simple approach is to first estimate household consumption at basic prices by deducting the estimated margins and taxes. Then,

a PPI at basic prices can be used to deflate household consumption at basic prices. (The opposite way is also possible: estimate output at purchaser's prices by including margins and taxes, and deflating by a CPI.) The supply and use tables will balance automatically since only one price index is used per product.

Although this approach is attractive in the sense that it is easier to implement, the clear drawback is that a less appropriate price index (a PPI) is used to deflate consumption, while in fact the more appropriate price index (a CPI) is readily available. Not only valuation is important for appropriateness of deflators, but also whether the price index reflects accurately the prices of the products included in the flow (see section 2.3).

It is important in such a case that a check on plausibility is made by comparing PPIs with CPIs.

2.1.4. The case of price discrimination

In section 2.1.1 it was said that - in a Laspeyres volume/Paasche price framework - the data at previous year's prices should balance, i.e. that the quantities of supply and use in year T valued at prices of year T-1 should be equal. This is based on the following logic. Each individual transaction is a contract between one seller and one purchaser for one quantity and at one price. For both seller and purchaser, the price and quantity increase compared to the base year transactions are the same. In principle, one could express each transaction in the price that prevailed in the base year, and add all transactions together, so that supply and demand will balance.

In some cases, however, it is not possible to compile a consistent Supply and Use Table balance in which supply and use are distributed by producers and consumers. These cases are where price variations exist between different consumers of a product that cannot be attributed to quality changes, such as cases of price discrimination, parallel markets or limited information (see ESA 2010 par. 10.13 and further). Price variations due to price discrimination do not constitute differences in volume (ESA 2010 par. 10.16).

Take the very simple example where there is one producer of a product that is sold to two different customers. First consider the elementary situation where the product is sold at exactly the same price to both customers.

	Supply			Customer 1			Customer 2			Total use		
	Quantity	Price	Value	Quantity	Price	Value	Quantity	Price	Value	Quantity	Price	Value
Year T	100	15	1500	60	15	900	40	15	600	100	15	1500
Volume T (prices T-1)	100	15	1500	60	15	900	40	15	600	100	15	1500
Year T-1	100	15	1500	50	15	750	50	15	750	100	15	1500

The 100 units of output are evenly distributed over both customers in year T-1. The distribution of output changes in year T but it is assumed that the price does not change, so that the volume in year T equals the value in year T. The volume of supply equals the sum of the volumes consumed.

Now suppose that the seller charges different prices to both customers.

	Supply			Customer 1			Customer 2			Total use		
	Quantity	Price	Value	Quantity	Price	Value	Quantity	Price	Value	Quantity	Price	Value
Year T	100	14	1400	60	10	600	40	20	800	100	14	1400
Volume T (price T-1)	100	15	1500	60	10	600	40	20	800	100	14	1400
Year T-1	100	15	1500	50	10	500	50	20	1000	100	15	1500

Again, it is assumed that the prices don't change. However, we would observe a decrease in the average price the producer receives for its output from 15 to 14 due to the change in composition of the buyers. The volume of supply ($1500=100*15$ using the average price of supply in year T-1) no longer equals the sum of the volumes of uses ($600+800=1400$).

Since this is a case of pure price discrimination, i.e. one homogeneous product sold at different prices to different customers at the same time, the effect on the average price should be included in the price component rather than the volume component (see section 1.3). There is no change in the total quantities, nor in their qualities. The correct volume index of output should therefore be 1, and the volume of output 1500. In this situation, the volumes of supply and use *cannot* balance, unless the volumes of uses are increased to add up to 1500. This would however distort the volume indexes for these categories.

In practice, there will not be many cases of pure price discrimination. A well-known example is electricity supply (see section 4.4). A pre-condition for price discrimination is that the product is sold under exactly the same conditions. This will not be the case in most situations. Price differences usually reflect different qualities of the same product or different circumstances under which they are sold. In that case, the change in the average price of the output should be attributed to the volume component (i.e. volume of output equals 1400). This can be achieved by subdividing the product into two products according to their prices, i.e. by treating the product as consisting of two different products.

In practice, even with detailed supply and use tables, it is rarely possible to identify purely homogeneous products, which makes it also very difficult to identify pure price discrimination. Heterogeneity of product groups can be a good reason for price variation across uses, and it is not always possible to subdivide a group of products in order to make them more homogeneous.

2.2. The three principles from the Commission Decision

Commission Decision 98/715 specified three main principles concerning the measurement of prices and volumes in national accounts. The three principles concerned the level of detail applied in the calculations, the choice of index formula and the choice of base year. Below, these three principles are briefly reviewed.

It is important to note that for these fundamental issues, it is desirable that all countries base their calculations on the same principles. Therefore there is no A/B/C classification specified here.

2.2.1. The elementary level of aggregation

The first principle formulated by the Commission Decision relates to the level of aggregation:

Principle 1:

*In the measurement of prices and volumes a detailed level of aggregation of products shall be used. This level of aggregation, which is referred to as the elementary level of aggregation, shall be at least as detailed as the A*64 / P*64 level of ESA 2010, for output as well as all categories of (intermediate and final) use.*

The measurement of prices and volumes should start from a detailed breakdown of products for the different transaction categories. For each product distinguished for each transaction category, a price index should be found with which the current price value can be deflated, or a volume indicator should be found to extrapolate a base year value. In the ideal case, each product would be distinguished separately, and the pure price and volume changes of that product could be estimated.

In statistical practice, however, it is necessary to aggregate products, which means that price and volume changes of different products have to be weighted together. The statistical sources from which the price indices and volume indicators are derived can use differing weighting methodologies (i.e. differing formulas or differing base years). In the national accounts, however, one consistent weighting methodology for all variables has to be used (see the second and third principles below). If indices with a different weighting methodology than the national accounts weighting are used in the national accounts, then implicitly the assumption is made that the indices used are elementary indices, so that the underlying weighting scheme is assumed to be irrelevant. Then, a fixed-weighted Laspeyres index can for example be assumed to be equal to a Paasche index, or a previous-year weighted Laspeyres index. Clearly, the implicit assumption that the indices used are elementary indices is most valid when it is applied on a very detailed level.

Therefore, the more detailed the product breakdown is, the more accurate the results can be expected to be. At a detailed level the products can be assumed to be more homogeneous, yielding indices that are closer to elementary indices, as well as more detailed weighting schemes. Also, by distinguishing more products,

the quality change that lies in the shifts between products is better covered (see section 2.4). It may well be that the effect on the overall GDP growth figure of introducing more detail is larger than the effect of the choice of base year or index formula.

In practice, there is however a limit to what can reliably be broken down. For example, the more detailed the product groups for which price indices are compiled, usually the smaller the sample of prices and products becomes. It might therefore be that the reliability of a more aggregated price index is higher than of a more detailed index.

For the purpose of this handbook, the term *elementary level of aggregation* is used to denote the precise level of aggregation at which the assumption that the indices used are elementary indices is applied in the national accounts. It is often - but not necessarily - equal to the number of products distinguished in the supply and use tables which are used for balancing purposes.

It is clearly essential that an effort is made in constructing detailed breakdowns of products for deflation purposes. As quoted above, for the EU Member States, the elementary level of aggregation, for output as well as all categories of (intermediate and final) use, should be at least as detailed as the A*64 / P*64 level of the ESA 2010 Transmission Programme requirements, and the level that is to be used for the submission of supply and use tables to Eurostat. In practice, to obtain good results, this level is probably far from optimal, and more detailed breakdowns need to be used.

Additional minimum breakdowns for estimating deflators or volume indicators are described for some transaction categories in chapters 3 and 4.

2.2.2. The choice of index formula and base year

Having defined the elementary level of aggregation, the price and volume indices available at that level have to be weighted together to obtain the price and volume measures of all national accounts aggregates. The second principle relates to the choice of index formula to be used for this purpose. This issue is related to the choice of base year, which is dealt with by the third principle.

Principle 2:

Volume measures available at the elementary level of aggregation shall be aggregated using the Laspeyres formula to obtain the volume measures of all national accounts aggregates. Price measures available at the elementary level of aggregation shall be aggregated using the Paasche formula to obtain the price measures of all national accounts aggregates.

Principle 3:

Volume measures derived at the elementary level of aggregation shall be aggregated using weights derived from the previous year.

2008 SNA, chapter 15, contains a full description of the various index formulae, their relationships, advantages and disadvantages. Here, we will only summarise the essentials.

The most frequently used index formulae in national accounts are those of Laspeyres, Paasche and Fisher. Essentially, Laspeyres uses weights from a base year, Paasche from the current year and Fisher is the geometric average of Laspeyres and Paasche and hence the weights are a combination of base year and current year values. Simplified, the following relationships hold:

$$\begin{aligned} \text{Value index} &= \text{Laspeyres volume index} * \text{Paasche price index} \\ &= \text{Paasche volume index} * \text{Laspeyres price index} \\ &= \text{Fisher volume index} * \text{Fisher price index.} \end{aligned}$$

The term "base year" has a slightly different meaning in the context of Laspeyres/Paasche and Fisher indices. In a Laspeyres volume index, the base year is the year whose current price values are used to weight the detailed volume measures. Using Laspeyres volume indices results in values expressed in prices of the base year, e.g. it gives what GDP would have been if the quantities of 2011 were produced against the prices of 2010. This is the traditional and most easily interpretable form of volume data. In principle, any year can be chosen as base year, but in national accounts only the previous year is allowed. The base year should be distinguished clearly from the reference year (see section 2.2.3).

In a Fisher index, the "base year" is a sort of average of two years, of which one is the current year. Normally Fisher indices are calculated on the basis of the previous year and the current year. The advantage of that is that the weights are the most representative for the periods compared, which reduces the so-called substitution bias (see e.g. 2008 SNA, par. 15.16 and further). Using Fisher indices however does not lead to volume data that can be interpreted in the above "traditional" way. One can of course deflate a value by a Fisher price index, but the result cannot be interpreted as the value of that transaction in prices of the base year.

Laspeyres volume indices have the convenient property that the volume data are additive when expressed in prices of the base year (but not necessarily when expressed in prices of another year, see section 2.2.3). Additivity means that the volumes of sub-aggregates add up to the volume of the aggregate. Additivity is not an essential property of volume data, but it is convenient, because it allows the balancing of volume data as outlined in section 2.1 and the construction of internally consistent volume supply and use tables.

Fisher volume data are non-additive, even if the base year is a recent one. That makes it impossible to use Fisher indices in a balancing process of volume data, nor to compile consistent supply and use tables in previous year's prices. It is possible, however, to compile Fisher indices for the aggregates after the balancing of the supply and use tables (using Laspeyres/Paasche) is completed. This would assume that the price and volume indices as given by the Supply and Use Table framework are elementary indices.

A close substitute to Fisher indices is however to use Laspeyres volume and Paasche price indices combined with the most recent weights, normally those of the year prior to the current year. The Laspeyres/Paasche combination then gives additive data in prices of this base year. It might well be that the benefit of being able to balance the volume data, and thus to carefully check all data on consistency and reliability, adds more to the precision and validity of the estimates than using Fisher indices. According to ESA 2010 (10.20) the use of Laspeyres volume/Paasche price indices on the basis of previous year's weights is mandatory. This choice is essentially a compromise solution: it gives additive volume data at the expense of a somewhat larger risk of substitution bias.

2.2.3. The non-additivity problem

For a discussion of the non-additivity problem it is convenient to make a clear distinction between the *base year* and the *reference year*:

- the *base year* is the year whose current price values are used to weight the price and volume measures derived at the elementary level of aggregation;
- the *reference year* is the year which is used for the presentation of a time series of volume data. In a series of index numbers it is the year that takes the value 100.

For example take the following series of index numbers:

2005	2006	2007	2008	2009
100	105	108	112	120

Suppose these numbers were calculated using the weights of the previous year. This could for example lead to the following series of year-to-year changes:

2005	2006	2007	2008	2009
100	105	102	103	106

For each of these indices holds: $t-1 = 100$, hence the reference year is equal to the base year, but changes each year. It is easily possible to express the series on one reference year by 're-referencing' or 'chaining'. This would yield:

2005	2006	2007	2008	2009
100	105	107.1	110.3	116.9

($107.1=105*102/100$; $110.3=107.1*103/100$, etc.)

It is important that a change of the reference year does not affect the year-to-year indices. This is obvious for a single series as in this example, but when a variable consists of several sub-variables this is no longer obvious. To keep all year-to-year growth rates of each variable unchanged when the reference year is changed, one should re-reference each variable separately, be it an elementary index, a sub-total or an overall aggregate such as GDP. The consequence is that, in the chained volume data of a fixed reference year, discrepancies will arise between individual elements and their totals. This is the 'non-additivity' problem. These discrepancies have to remain in the published data without adjustment (ESA 2010, par. 10.23), as

any adjustment would again distort the growth rates. See the following example for further clarification.

Example: Re-referencing aggregates and their components

Consider two products A and B, and their total. Assume that these are homogeneous products; that means that we can determine price and volume indices for these products which do not depend on an underlying weighting scheme, i.e. these are elementary indices. The volume and price indices for A and B combined however depends on how A and B are weighted together.

In the following scheme, the volume changes for the total between t-1 and t are weighted together by the current price values of year t-1. As these are the most up-to-date weights these growth rates can be seen as the most accurate.

	Product A	Product B	A & B combined
2005 current prices	100	300	400
Volume change 05-06	105.0	110.0	108.8
2006 at prices of 2005	105	330	435
Price change 05-06	110.0	95.0	98.6
2006 current prices	115.5	313.5	429.0
Volume change 06-07	102.0	90.0	93.2
2007 at prices of 2006	117.8	282.2	400.0
Price change 06-07	108.0	105.0	105.9
2007 current prices	127.2	296.3	423.5
Volume change 07-08	103.0	95.0	97.4
2008 at prices of 2007	131.1	281.4	412.5
Price change 07-08	105.0	102.0	103.0
2008 current prices	137.6	287.1	424.7

Now suppose these data have to be expressed in a fixed reference year, say 2005. To avoid distorting the growth rates of the total, we must re-reference each series separately. In index form (2005=100) this will become:

	Product A	Product B	A&B combined
2005	100	100	100
2006	105.0	110.0	108.8
2007	107.1	99.0	101.4
2008	110.3	94.1	98.8

Where for example $101.4 = 108.8 * 93.2 / 100$ and $98.8 = 101.4 * 97.4 / 100$

In terms of volumes with reference year 2005, we have:

	Product A	Product B	A&B combined
2005	100	300	400
2006	105.0	330.0	435.0
2007	107.1	297.0	405.6
2008	110.3	282.2	395.0

Clearly the sum of A and B is no longer equal to A & B combined. This is the well-recognised non-additivity problem. Despite this problem, the “correct” volume for 2008 is 395.0 and not $110.3 + 282.2 = 392.5$. 395.0 is the only figure consistent with the previously calculated growth rate of the combined products. Moreover, in this way the year-to-year growth rates will not change with a change of reference year. The differences between A, B and their combined volume estimate must not be removed, but have to be explained to users. The differences cannot be interpreted as an indication of the reliability of the results.

However, it should be noted that the chained values are *indirectly* additive when using the sum formula:

$$A\&B_t = A\&B_{t-1} \left(\left(\frac{A_t}{A_{t-1}} * \frac{A_{t-1}^{curr. pri.}}{A\&B_{t-1}^{curr. pri.}} \right) + \left(\frac{B_t}{B_{t-1}} * \frac{B_{t-1}^{curr. pri.}}{A\&B_{t-1}^{curr. pri.}} \right) \right)$$

The use of the sum formula is illustrated below for 2007 with data from the table above.

$$A\&B_{2007} = 435 \left(\left(\frac{107,1}{105,0} * \frac{115,5}{429} \right) + \left(\frac{297,0}{330,0} * \frac{313,5}{429} \right) \right) = 405,6$$

The sum formula provides the possibility to add series of chained values which in many cases can be of good value. For example it can be used to calculate the sum of gross value added (GVA) for a range of industries where the chained GVA figures for each industry are already available. Moreover, the formula can be re-arranged to be used as a formula of subtraction of chained values. This could for example be used to calculate GVA for "all industries" excluding one or more selected industries. The sum formula as presented above can easily be generalised to n elements.

The choice of base year and the choice of reference year are in principle unrelated issues. For the calculation of price and volume measures, only the choice of base year is relevant.

Because of the need to re-reference or chain data calculated with the previous year as base year are to be expressed in a fixed reference year, this system of always using the previous year as base year is also known as a system of "chain indices". However, for the calculation of the year-to-year price and volume changes, no chaining is required.

2.3. Criteria for appropriate price and volume indicators

There is duality in the measurement of prices and volumes: one can either deflate a current year value with a price index, or alternatively extrapolate a base year value with a volume index to arrive at an estimate in prices of the base year. Therefore, only one of the two possible measures is required, and the other can be derived as a residual.

The two alternative approaches are in practice however not entirely equivalent. Deflation with a price index is generally preferred. There are two reasons for this:

- A sample of price observations is normally more representative than an equally sized sample of quantity observations. In an open market there cannot be large differences in the changes of the prices charged for the same product by different producers. There can however be significant differences in the changes of the quantities of that product produced by different companies. This makes it necessary to have larger samples for quantity indicators than for price indicators. In fact, for quantity indicators one would prefer to have nearly exhaustive observation of all transactions.
- Price index compilation is usually based on the fixed-basket methodology: the prices of a fixed basket of precisely specified goods and services are compared between two periods. In this way, the quality of the goods and services compared is held constant, and the price index measures pure price changes. If a quantity or volume index is compiled directly, there is no guarantee that the units counted in one year are of the same quality as in the next year, unless one has very detailed quantity information dealing with homogeneous products. It is therefore more difficult to control for quality changes when volume indicators are used (see also section 2.4.3).

For each approach there is a variety of different indicators that can be chosen. To assess the appropriateness of an indicator the following general criteria can be used (drawn from Commission Decision 98/715, p.40):

- the completeness of the coverage of the product heading by the indicator. For example whether the indicator covers all of the products under the heading or just a selection of them, such as only those products sold to households;
- the valuation basis of the indicator. For e.g. market output, this should be basic prices, rather than, for example, purchasers' prices or input costs, whilst for e.g. final consumption expenditure it should be purchasers' prices;
- the indicator should take quality changes into account, recording them within the volume estimates (see section 2.4);
- the conceptual consistency between the indicator and the national accounts concepts.

Indicators satisfying all four criteria generally will constitute A methods. If one or more criteria are not satisfied, the methods will become B methods or C methods according to how far away the method is from an A method. The precise distinction between A, B and C depends on the product and its specific circumstances. For example use of an indicator relating purely to prices charged to household consumers would be a B method if it could be shown that business prices closely followed household prices or that the proportion of business expenditure in total expenditure on the product was sufficiently low. It is important that appropriate research is undertaken to determine if use of a particular indicator can lead to systematically poor or biased estimates.

2.4. Quality changes

2.4.1. The problem of quality changes

The measurement of year-on-year price changes of goods and services is complicated by the fact that these goods and services may change between those years. The observed price changes may reflect changes both in characteristics and pure price changes. A value has then to be estimated for the change in the characteristics, in order for the price index to reflect pure price changes only. This is commonly known as the problem of quality changes.

The quality of a product is defined by its (physical and non-physical) characteristics. In principle, whenever a characteristic of a product changes, it is to be considered a different quality of the product. These changes in characteristics are to be recorded as changes in volume and not as changes in price (cf. ESA 2010, par. 10.18).

Valuing those quality changes is one of the most difficult problems in price and volume measurement. For a producer, quality change of an input will be related to its use in the production process and the profit that can be made, and it might be possible to more or less objectively put a value to the change. For a consumer, however, the quality of a product is essentially linked to the utility he or she gets

out of it. Utility is not quantifiable, making the measurement of quality change for consumers a rather subjective matter. In economic statistics, one can only analyse aggregate consumer preferences as revealed by their purchasing behaviour, on the basis of observed market prices.

According to economic theory, in a situation of perfect competition the market price of a product will reflect both the purchaser's preferences and the producer's production costs. The market price will reflect exactly what the purchaser wants to pay for an extra unit of this product as well as what the producer needs to receive in order not to make a loss.

In this situation, a difference in price that exists between two products at the same time can be interpreted as the value that consumers attach to the quality difference between the two products. This implies that a higher price is associated with a higher quality. If shifts in the quantity of consumption occur between the different products this should be seen as a volume change, implying that the quality difference between the two products is exactly equal to the price difference.

Unfortunately, in most cases there is no perfect competition. Generally, price differences between different products can exist for various reasons. For example, consumers do not always have perfect information, leading them to buy at too high prices. Also, markets may not react promptly to the introduction of new products. It can happen that the "old" products are being put on sale when new products are introduced, implying that the difference in price between the old and new products cannot immediately be used to value the quality difference. Other reasons for price differences may be price discrimination and the existence of parallel markets. All the price differences mentioned here should be seen as price differences and not as quality differences (see ESA 2010, par. 10.14 – 10.18).

In some markets, e.g. for computers, it frequently occurs that new products have a higher quality but are introduced at the same, or a lower price than the old products. In such a case, the usual assumption that a higher price corresponds to a higher quality is no longer valid.

Therefore, market prices do not always properly reflect quality differences. The situation of perfect competition can however be used as the benchmark situation, i.e. the prices that would occur in a perfect competition situation would give us the correct quality evaluations. The correct quality adjustments can – in theory – be found by analysing the market prices *supposing* that perfect competition would prevail. The appropriateness of a particular method for quality adjustment therefore depends on the characteristics of the market in question: if a market is close to perfect competition, comparing market prices will usually give good results. If a market is further from perfect competition, e.g. due to the existence of a monopolist, perhaps other methods should be sought.

The limiting case of quality changes is when new products appear on the market. In such a case it is impossible to find prices that can be compared between the two years. It is important that new products are introduced into price samples as soon

as possible after they appear on the market. At the moment of introduction, an estimate has to be made of the price of the new product in the period just before its introduction. The methods that can be used for making such estimates are not essentially different from the methods to deal with quality changes that will be described in the next section.

2.4.2. Accounting for quality changes in price indices

The conventional approach to the compilation of a price index for a particular good or service is to follow the prices of a fixed sample of items over time. The price changes are averaged to obtain the price index for the product. The rationale behind the fixed sample procedure is to make sure that only pure price changes are measured. However, in practice the goods and services in the sample do not remain constant: their characteristics may change continuously. Furthermore, there may be changes outside the sample, e.g. when new products are introduced.

The classical problem of quality adjustment can be posed as follows. An item, say item A in the price index for a certain product group disappears from the market. A new item, say item B, is chosen to replace it. How to measure the price change over time? Below, the various methods that were developed to answer this question are briefly described.

Overlapping

In many cases there will be one or more periods where both A and B are on the market (i.e. they “overlap”). In this situation prices are available for both item A and item B at, say, time t , so that price change up to t could be based on item A and after t , on item B.

It is then implicitly assumed that the price difference between A and B in period t is a measure of the value of the quality difference. As made clear in the previous section, whether or not this is a reasonable assumption depends on the market situation of the product in question. In situations that are close to perfect competition, the overlapping method will give appropriate results.

However, in certain circumstances, e.g. when new varieties of the product are introduced frequently and prices change quickly, the overlapping method may not give good results. The main problem is that very different results can be obtained depending on when items are introduced into, or dropped out of, the price sample. For example, if new models of computers are introduced into the price sample as soon as they appear and kept in the sample as long as they are sold, then it is likely that a rapidly declining price index will be the result because of the large discounting which applies to an old model once a new one is introduced. On the other hand, a price index which declines little (if at all) can be obtained if the prices of old models are dropped out of the sample as soon as a new model is introduced. For other products, other patterns may prevail. For example, cars are often introduced at reduced prices.

Unadjusted price comparison

(Also called “direct price comparison”.) This is a simple method in which the price difference between A and B is taken unadjusted into the index. Thus it is assumed that there is no quality difference between A and B. This method is clearly not suitable in areas of rapid quality change such as high-tech goods.

Automatic linking

(Also called “link-to-show-no-price-change”.) In this method, the items are simply called non-comparable and the price level is considered unchanged. Hence, the measured price difference is fully attributed to the quality change. This method generally gives a systematic underestimation of inflation and is therefore banned by EU regulation for the HICPs.

Matched models only

(Also called “imputation” or “imputed price change – implicit quality adjustment”.) This method includes in the price index only the price changes of items that exist in the two periods compared, while disregarding all non-matching items. So, items A and B will both be dropped from the sample, and the price index is only based on those items for which no quality change occurred. The implicit assumption is that the price change of the matching items is representative for the price change of the non-matching items. Whether this is realistic depends on the extent in which price changes are introduced at times when new varieties of products are introduced, which is the case in many markets.

Option prices

If the difference between A and B is the inclusion of an extra option, for example a CD-ROM drive in a PC, this option could be valued by its price as if it were purchased separately. Thus, if B includes a CD-ROM drive, then its price can be reduced by the price of that drive to arrive at an estimate for the price of A, which didn't have the CD-ROM, in period t.

It is however not always the case that the price of the product with the option is equal to the price of the product plus the price of the option. For example the price of separately purchased software is usually much higher than if it were purchased together with a PC.

Clearly, this method is only possible when the quality difference can be described in this way and when a separate price for the option exists. Note that this method uses prices to the consumer and not production costs.

Production costs

In some cases, there will not exist a separate price for the new option. In such cases the producer can be asked how much the new option costs to produce. More generally, producers can be asked for data on the difference in production costs

between A and B. Note that in this method costs are used instead of prices, so that the user's preferences are not taken into account. The method can be improved in this respect by including the producer's profit margin.

Judgmental approach

Another possibility is to ask the producers, consumers or other experts to give an estimate of the value of the quality difference between A and B. This method is for obvious reasons rather subjective, and its results cannot be objectively verified.

Hedonic adjustment

In this method, data on the market prices and characteristics of various models of a product are collected. A regression is carried out to investigate which characteristics are the determinants of the price differences between the models. Two basic variants of this method exist:

- Calculate the implicit prices of each of the characteristics. This information can then be used to estimate a price for an item in a period in which it was not on the market.
- Calculate the price index directly from the regression. In such a case the regression usually will contain time dummy variables whose coefficients will reflect those price changes that cannot be associated with a change in the characteristics.

In the literature, many examples of the second variant are found. These are usually backwards looking studies in which the price movements over a number of years are estimated in one regression. This variant seems to be less appropriate for official price statistics when, in a continuously running program of price observations, adjustments have to be made as quality changes occur.

The first variant seems more relevant for official statistics. It can be used alongside other methods of quality adjustment. The implicit prices are estimated in a particular base period and then used in a number of periods. The hedonic method is mostly used in cases where there are rapid changes in the products, such as in the computer market. In those cases, the regression will have to be re-estimated frequently (at least more than once a year) since the characteristics and their prices will change often.

The hedonic method is only possible when characteristics can be defined that influence the price and can be quantified.

The OECD published a Handbook on Hedonic Indices and Quality Adjustment in Price Indices (http://www.oecd-ilibrary.org/science-and-technology/handbook-on-hedonic-indexes-and-quality-adjustments-in-price-indexes_643587187107), in which the technical aspects of hedonics are elaborated as well as a comparison is made with other quality adjustment methods.

Resampling

This method could also be labelled aggregate overlap pricing. It means that in each period a new sample of items is priced. Thus up to, say, period t the estimate of the price change is based on an old sample called A, and after t on a new sample called B.

As for simple overlap pricing, resampling depends on the differences between average prices between A and B to be genuine reflections of quality differences.

A version of this method that has been informally tested and found interesting in a CPI context is called “Monthly Chaining and Resampling” (MCR). This involves observing the prices of all varieties (or at least a representative sample of them) of a product that are on the market each month (hence monthly resampling). The price change is then computed from one month to the next as an average over those items that are in the sample in both months. Price changes between months that are further apart are calculated by multiplying the month-to-month changes (hence monthly chaining).

The advantage of the method is that the sample of matched models that determine the price index is sufficiently large due to the monthly resampling. The difference with traditional methods is that one no longer tries to follow the same sample through time, but instead one looks at what is actually on the market in each period. New products are therefore included earlier than with a fixed basket. Preliminary testing seems to have shown that indexes based on this method yield similar results as hedonic indices.

2.4.3. Accounting for quality change in volume indicators

When a volume measure is not obtained by deflation with a price index but instead by extrapolation with a volume index, quality changes should also be accounted for. This however provides some special problems.

Suppose for example that we would measure the volume of the output of cars by the number of cars sold. However, the quality of cars is constantly changing. Suppose we managed to find an indicator for this quality, say the maximum speed the car can reach. How can the quantity indicator then be combined with the quality indicator? If the car can now do 200 km/h instead of 180 km/h, is that then a quality change of $(200-180)/180 \cdot 100 = 11\%$? Should the number of cars be adjusted with this percentage? It is clear that a number of very arbitrary calculations are made in such a case. In general, there seem to be few objective criteria to link quality indicators to quantity indicators.

One possible solution is to adjust the implicit prices. Quality adjustments are, as spelled out in section 2.4.1, essentially a matter of putting a money value to changes in products. If the total turnover of cars were divided by the number of cars, an implicit (average) price of cars would be found. Then, an estimate needs to be made of the price increase of the cars that is due to the increased

capabilities, that is the value that consumers attach to this increase in speed. For this, the same approaches can be used as listed in the previous section.

When volume indicators with a detailed breakdown of products are used, shifts between the different products will be included in the volume component. Therefore, part of the quality change (that part due to compositional changes in an aggregate, see section 1.3) can be captured by differentiating as many qualities of a product as possible. These different qualities are then in fact treated as different products.

2.4.4. A, B and C methods

The most appropriate method for quality change will depend to a large extent on the particular circumstances. A few general criteria can be specified however. An appropriate method for quality adjustments:

- makes explicit evaluations of the quality change rather than implicit ones;
- does so in a verifiable way;
- takes both user's preferences and producer's costs into account (normally by considering differences in market prices).

In general, the following methods can become A methods if applied under the right circumstances:

- the hedonic approach, if characteristics can be identified that influence the price and can be quantified;
- option prices, if separately priced options can be distinguished, and the price of a separately purchased option is not very different when it is included in the product;
- overlapping, if there is no large discounting of an old item when a new item is introduced;
- the resampling method, if the sample is representative and large enough.

Those methods will become B methods if they are applied under less favourable circumstances. For example, resampling is less good if the sample size is less than optimal, and the hedonic approach should be used with care if the hedonic function only explains a limited part of the price variation.

Similarly, the following methods for quality adjustment could be B methods, again subject to the circumstances in which they are used:

- matched models only, if the price change of the matching items is reasonably representative for the price change of the non-matching item;
- production costs, if it can be shown that the change in costs gives a reasonably good approximation of the change in price;
- judgmental approach, if expert knowledge is available.

The unadjusted price comparison method should normally be avoided, unless it is clear that the quality change is really very small. The automatic linking method is always a C method.

Some methods are more suited to some products, other methods to others. In the various sections of chapter 4, where necessary and appropriate, further specifications of this general A, B and C classification will be given. If there is no further specification, the above guidance should be applied.

2.5. Unique products

A price index is based on the comparison of movements in prices for a selected set of products across a period of time. But there is a particular problem with unique products which are by definition “one-offs” and do not appear in another time period. One can view this as the appearance of a new product and the immediate disappearance of it – the unique product represents a discontinuity in the calculation of price indices.

The problem of unique products is especially prevalent in the areas of major equipment projects (for example ships, aircraft and special purpose machinery), construction, intellectual property products such as R&D services and tailored business services (for example management consultancy). These areas are covered in sections 4.3.2, 4.6, 4.12 respectively.

In many cases, whilst a project may be seen as unique in its entirety, it is likely to be made up of a number of rather more generic sub-activities. The uniqueness arises more from the way in which these sub-activities are combined, rather than the activities themselves. For example a house may look unique, but actually it is made up of a series of contributions of skilled tradesmen, who may well be producing what for them seems like a more or less standard product.

There is obviously fertile ground here for examining the sub-activities separately, to see if their price movements can be combined meaningfully to an overall price movement for the unique product. There are two ways of looking at this in aggregate:

i) Model Pricing: This is where a model product is specified in some detail (usually based on real past products), then the contributory elements are re-priced in successive time periods. An example of this is in construction, where one can specify a typical family house, say, and then re-price all of the constituent elements (such as roof, foundations, kitchen unit) of that house in successive periods. For business services, there may be a standard (or generic) contract which can be used. The key criteria for the use of model pricing are:

- Regular updating of the models used, to ensure that they do not become out of date;

- Representativeness of the models – partly this is achieved through regular updating, but also choosing models that are applicable across regions (for example house designs can vary between different regions, so a suitable range of models is needed);
- Use of actual prices charged, taking account of the producers' profit margins and any discounts offered to customers. This applies first of all if the model is based on an actual (past) product. Furthermore, for the estimation of the price of the model when it no longer exists, an attempt should be made to take into account usual discounts offered in this industry;
- Formulation of the model in terms of outputs, not of inputs. For example, a model should not contain specifications like "a contract of 100 hours of work", but rather "a tiled wall of 20 square metres".

ii) Specification pricing: This is where a real product is broken down into a number of key elements or components, which are priced, and then in successive periods, individual projects are examined and the key elements compared. Crucially, the elements should be separately identifiable, their qualities and impact on final performance of the product should be quantifiable, and prices should be available in different periods. This method differs from the "model pricing" approach because no ideal models are actually specified. It has the advantage that there are no model products to become out of date, but of course the key elements identified in the specification method may be less and less relevant over time, and it is important that the key elements are measured in terms of outputs rather than inputs.

There are clear similarities between these methods and the hedonic method explained in section 2.4.2. In the hedonic method, regression analysis is used to determine the characteristics of products that are the main determinants for the price. Those characteristics can be, but are not necessarily, components of the products.

Both model pricing and specification pricing are resource-intensive methods. In certain cases, international co-operation in developing such methods could be useful. Section 4.3.2 on large equipment goods describes this in some further detail, including also the possibility of "importing" price indices from other countries.

A, B and C methods

The breakdown of methods is described in more detail in the various sections dealing with the respective products (cited above). In general:

- Methods that decompose a product into meaningful and measurable sub-products (such as model and specification pricing) are A methods. If any of the first three criteria set out above (regular updating of models, representativeness, actual prices) are not met, then the method becomes a B method.

- The use of international price indices can be a B method for certain products (see section 4.3.2).
- The use of input prices is a B method for unique production, such as R&D services, as the methods described above are not applicable. .
- In other cases a method (including a decomposition method) which relies wholly on measurement of inputs or uses unadjusted quantity indicators is generally considered a C method. The unit value method is also considered a C method for unique products because, by definition, unique products are not produced in batches of homogenous units.

2.6. Unit values versus price indices

In some cases, a choice can be made between a 'unit value index' and a price index. Traditionally, unit value indices appear in foreign trade statistics and the discussion on the pros and cons of unit value indices and price indices takes place in the context of deflation of exports and imports, see section 3.9. However, the arguments used in this discussion can also be used in other contexts, such as the deflation of compensation of employees, or the price measurement of certain business services. This section will develop these arguments in a general way, which can subsequently be applied to numerous individual cases.

A price index is based on the observation of prices of a fixed sample of products in two different periods. The reliability of the price index depends to a large extent on how representative the sample is. If the sample misses out a significant portion of the universe of products, and the missing part has a price trend that is significantly different from the sampled part, the resulting price index will be distorted. Also, the sample needs to be kept up-to-date by introducing new products and removing products no longer available in a timely way.

A unit value index is based on a – usually – exhaustive observation of the total value and the total quantity of a group of products. A 'unit value' is calculated by dividing the total value with the total quantity. Comparing this unit value in two different periods gives a unit value index, which can be used as a measure for the price trend. While complete and thus representative coverage of the observations is guaranteed, the problem in this method is the heterogeneity of the products, which can cause a large variability in the index. Furthermore, any changes in the composition of the products can influence the unit value index resulting in a price change although such changes should in fact be included in the volume component. It is not possible to adjust unit value indices for quality changes in the products in the same way as can be done for price indices.

This can be illustrated by the following example, where prices and quantities of two products (A and B) are known in two years.

	Product A			Product B			Total		
	Quantity	Price	Value	Quantity	Price	Value	Quantity	Average price	Value
Year T-1	10	10	100	5	20	100	15	13.33	200
Year T	5	10	50	10	20	200	15	16.67	250

Resulting indices:

Unit value index (uvi) = $16.67/13.33 = 125$ -> Volume index based on uvi = 100 = change in total quantity.

Paasche price index = 100 -> Laspeyres volume index = 125

There is no change in prices or in total quantities. However, the switch from the cheaper product (A) to the more expensive product (B), which should be a volume effect, is reflected as a higher unit value. Using the unit value index as a deflator thus overstates the price change (which is zero), and understates the volume change. The Paasche price and Laspeyres volume indices show the correct impact on price and volumes of the change.

In this example, all prices show the same trend (they are in fact both unchanged), so that any price index will be representative. In reality, the price changes of the different products will be different, making separate price observation for each product necessary, plus the need for individual weights (derived from the shares in the total value).

If the shares of the different products in the total quantity remain constant, the unit value index will give the correct result, whatever the price changes are. So, the appropriateness of unit value indices depends on the stability of the composition of the group of products.

In practice, the need for a stable composition of products is often a very restrictive one. Even seemingly similar products can in fact have quite different qualities with totally different prices. For example, a product group called "salt" might seem quite homogeneous but may in fact comprise different qualities of salt that have very different prices. However, in general it can be said that the more detailed the product groups are defined, the more homogeneous they can be expected to be, and thus, the more appropriate unit value indices will be.

Notice that in the example no problem would exist if A and B were deflated separately. Unit value indices and price indices would both give a perfectly correct solution for both products. Therefore, the example also indicates the importance of collecting information and deflating at a product level that is as detailed as possible: at a detailed level unit value indices and price indices converge. This point will come up in many instances in this handbook.

The distinction between unit value indices and price indices can also be applied to other examples. For example, for the deflation of wages and salaries, one can sometimes choose between a wage rate index and an index based on average wages (see also section 3.53.11.2). The wage rate index will be based on a sample of wage rates for representative categories of employees, that have to be weighted with the share of these categories of employees in the total wages and salaries. This is equivalent to the procedure of compiling a price index. Some countries possess a database of wages of all employees (for the government sector for example). With such an exhaustive database average wages can be calculated for the different categories of employees, yielding an index of average wages. This is equivalent to a unit value calculation. The result depends entirely on the stratification of employees chosen. In principle, both methods can yield the same result if applied at a very detailed level. If a country possesses such an exhaustive database it is difficult to find conceptual arguments for not using this source and favouring a sample of wage rate observations instead (there might be of course other reasons for using wage rates, e.g. the time they become available).

Another application of this discussion can be found in the compilation of deflators for some types of business services. Such services (of lawyers or accountants for example) are often paid for on the basis of an hourly fee. There are two ways of compiling an index of these fees. One could observe a sample of rates that these service providers use (this method is labelled 'charge-out rates' in this handbook) or one could collect data on total turnover and divide that by the number of hours worked (which is labelled the 'hourly fees' method). Again, the first method corresponds to the price index methodology (therefore dependent on how representative the charge-out rates observed are), while the second corresponds to the unit value approach (therefore suffering from the heterogeneity problem).

3. A/B/C methods by transaction category

3.1. Market and non-market output

This section will give general principles for the deflation of output. They will be made much more precise in chapter 4 where they are applied to each individual CPA product heading.

3.1.1. Market output and output for own final use

Market output and output for own final use will be dealt with together. ESA 2010, par. 3.45 states that “output for own final use (P.12) is valued at the basic prices of similar products sold on the market”. Therefore, when such prices are available, volume measures of output for own final use are calculated in the same way as market output.

At the outset, it is important to stress that an essential criterion for appropriate methods for market output is that the price or volume of the output itself is measured and not of a proxy for the output (such as an input or another output).

The discussion below and in chapter 4 focuses on output by product. To deflate total output of a branch, its output should first be classified into the various (primary and secondary) products produced, as is done in a supply table. Each product should then be separately deflated by an appropriate procedure. According to the Laspeyres volume framework as set out in chapter 2, the sum of the value of the products constitutes the value of the output of the branch measured in previous year prices.

3.1.1.1. Price deflation methods

Methods in this group all search for information on the price change of the output, so as to construct a price index with which the value of output in current prices can be deflated.

Deflation by producer price indices (PPIs and SPPIs)

PPIs come in many varieties. In this handbook, the term PPI will be used exclusively for an index of the price change of output of a product, whether it is a good or a service. Output includes both domestic uses and exports. The standard PPI compilation method is to observe the price of a sample of representative products produced by a local kind-of-activity unit or enterprise over time. The observed price changes are weighted by the shares these units or enterprises represent in the total output of the product. Indices for aggregate product categories (or industries) are derived by weighting with shares of the individual products in the value of total output (often national accounts data). This standard method is well established for manufacturing products and increasingly so for service products.

Deflation by PPIs can normally be considered to be the preferred method, since they directly measure product prices, and quality changes can be taken into account. However, PPI compilation requires specific surveys, which can be expensive and difficult to organise, especially for services. This handbook cannot be a guide to the practical compilation of PPIs. For this, one should consult the PPI manual prepared by the IMF. Also, the OECD Methodological Guide for Developing Producer Price Indices for Services and Eurostat's *PEEs in Focus: a summary of the services producer prices indices* provides guidance for the compilation of SPPIs.

PPIs are often compiled as Laspeyres price indices. As set out in section 2.2, in national accounts Paasche price indices should be used. That implies, that at the "elementary level of aggregation" (see section 2.2.1 for a definition), the assumption is made that the indices are elementary indices, i.e. that Paasche and Laspeyres indices give the same result. Clearly, the more detailed the level of aggregation, the more plausible this assumption is. It is recommended that regular tests are made to validate the assumption made. In certain cases, especially where price or quantity fluctuations are large, the PPIs could be recalculated to Paasche indices.

PPIs are usually compiled as monthly or quarterly indices. To deflate annual data with PPIs it is therefore necessary to take the structure of the flow through the year into account. If the volume of products produced is reasonably constant during the year, a simple average of monthly or quarterly indices can suffice. If, however, there are large fluctuations in the volume through the year, the sub-annual indices should be weighted by the volumes in each month or quarter concerned. Monthly information might be difficult to gather in practice though.

Model pricing or specification pricing

There are situations where the standard PPI compilation is difficult, for example when companies produce different products each year so that no prices can be compared. In such a case a "model price" or "specification price" approach might be a solution. Section 2.5 on unique products describes this in more detail.

The main advantage of model pricing is that it has an in-built consistency, since the same project or output is priced in different periods and so, in theory, product quality is unchanged. However, because of this in-built stability with model prices, there is an issue of whether the product remains representative, particularly in areas of rapid product change. So in order to keep the model representative, it needs to be updated regularly.

Another significant practical disadvantage is that contributors often have difficulties with delivering a model-price estimate – because of its complexity and the consequent impact on contributors' compliance costs.

Charge-out rates or hourly fees

In other cases it can be difficult to identify the products; this is particularly the case for some services. In connection with that, it can be difficult to identify a price: in some cases payment can be related to, for example, the number of hours worked (for instance by a lawyer) instead of to the output delivered. In the latter case, the *charge-out rate* (price charged per hour) can be used as a price indicator.

Whilst this has the relative advantage of ease of collection, productivity or quality changes will not be captured, because it does not take into account changes in the amount of work done per hour charged. Furthermore, charge-out rates suffer from the “list price” problem: the actual price paid can be quite different from the quoted charge-out rates, due to discounts negotiated on a bilateral basis. Similarly, *hourly fees* can be calculated by dividing total turnover by number of hours worked (this has similarities to unit value indices, see section 2.6).

Hourly fees and charge-out rate methods differ from input methods using wage rate indices (see below) in the fact that the operating surplus and other inputs including compensation of employees are included in turnover. In both methods, however, changes in the amount of work done per hour will be reflected as price changes rather than productivity changes.

The hourly fee method is best applied at a very detailed level, by defining the products in as much detail as possible, and by distinguishing between different types of labour.

Consumer price indices (CPIs)

CPIs are compiled for almost all goods and services consumed by households. If CPIs are to be used to deflate output (rather than household consumption), it has to be considered that business consumption and exports can differ significantly from household consumption in both mix of products and price changes. The appropriateness of using CPI information to deflate output depends therefore on the share of household consumption in total output and on the difference in price changes and composition between intermediate use and final use of the product group in question.

Also, CPIs normally measure the change in the purchasers' price of a product rather than the basic price, and therefore have to be adjusted to the correct price base if they are used for deflation of output. The adjustment has to take account of changes in trade and transport margins, and changes in the rates of taxes and subsidies on products. For example:

	Purchasers' price	Taxes on products	Trade margin	Basic price
Year T-1	17	2 (rate: 20%)	5 (rate: 50%)	10
Year T	19	3 (rate: 30%)	6 (rate: 60%)	10

In the example, the change in the purchasers' price is entirely due to changes in the tax rate and the margin rate. In practice, changes in the rates of taxes and subsidies are more easily observed than changes in the rates of trade and transport margins.

Obviously, if no distribution margins exist, no changes in tax or subsidy rates occur, and if households consume all output, then a CPI becomes fully equivalent to a PPI. This can for example be the case for personal services.

For CPIs the same Laspeyres/Paasche issue exists as for PPIs (see above). Also, the same principles apply regarding weighting infra-annual changes.

Unit values

Unit values are derived by dividing value information by quantity information (see section 2.6). Deflating a value of output in current prices by a unit value index therefore implies using the underlying quantities as the indicator. For these indicators, the same remarks are valid as those made for output volume indicators below.

Input prices

Lastly, one could take prices of inputs (e.g. the price of labour or a weighted average of prices of intermediate inputs) as an approximation for the price of the output. However, if the output would have a different path than the input, e.g. due to productivity changes, this method would have a clear bias. These methods should be avoided.

However, in situations where price measurement does not seem possible or feasible, input methods can be considered. This may be the case especially for services such as R&D and other special unique products.

In cases, where price indices from PPIs or SPPs are not available, input methods would be considered as a "B" method. The Short Term Statistics Regulation⁷ sets out the requirements for the collection of output prices by industry.

⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1998R1165:20120621:EN:PDF>

3.1.1.2. Volume extrapolation methods

In these methods indicators are collected that describe the trends in the volume of output directly. Volume indices are constructed and applied to the value of output in the base year to arrive at the volume of output in the current year.

Output volume indicators

In situations where price measurement does not seem possible or feasible, the direct measurement of the volume of output can be considered. This can be the case, for example, for service areas where consumers are implicitly charged for services provided, such as in banking and insurance (see section 4.11). In other cases, where there are very homogeneous products without large quality changes and detailed quantity information is available, it can be equivalent to price deflation.

Section 2.3 has already discussed briefly the major disadvantages of volume indicators relative to price indices. To overcome these disadvantages, volume indicators should:

- be collected at a very detailed level, so as to distinguish homogeneous products that do not change over time, and
- be representative for all outputs in question.

The use of output volume indicators might also be necessary in cases of high inflation. When prices change very rapidly, price indices become increasingly unreliable. To describe the real economic developments in such situations volume indicators might give better results. For a more elaborate discussion on high inflation see "Inflation Accounting: A Manual on National **Accounting** Under Conditions of High Inflation", published by the OECD in 2003.

Input volume indicators

In these methods, indicators on the volume of inputs (e.g. the number of employees or the volume change of intermediate inputs) are used to approximate the volume of output. The use of such methods means that the resulting data are biased when productivity changes occur. As for input price methods, these methods should be avoided.

3.1.1.3. A, B and C methods

A general classification of methods for measuring prices and volumes of market output into A, B and C methods is given below. In chapter 4, this general classification is further elaborated for each individual product heading.

A method: For deflating output, in principle, using appropriate PPIs will be an A method. Each product should be deflated separately by an appropriate PPI. An appropriate PPI satisfies the following criteria, based on the general criteria given in section 2.3:

- it is an index of the (domestic and export) price(s) of the output of exactly that (group of) product(s);
- it takes account of changes in quality of the product(s);
- it is valued at basic prices;
- the underlying concepts are consistent with the national accounts concepts.

Any method that can be shown to be fully equivalent to the use of PPIs can also be seen as an A method. This could for example be a CPI for a service that is only used by households, on which no distribution margins apply and for which tax or subsidy rates don't change. Or it could be output volume indicators that are fully representative, available on a detailed level and quality-adjusted.

B methods: If an appropriate PPI is not available, several alternative types of indicators exist. For example the following will usually be B methods:

- a less appropriate PPI, e.g. an index without quality adjustments, or having a smaller or larger coverage than the product heading;
- a Consumer Price Index (CPI). The same three criteria as for PPIs apply (CPIs will normally have to be corrected for taxes, subsidies and margins in order to obtain valuation in basic prices), and in addition the weighting should be appropriate and the concepts should correspond to national accounting concepts;
- output volume indicators that are not fully representative, lack quality-adjustments or are lacking sufficient detail.
- Input methods for unique products, if no other method can generate better results. Input methods are also considered B methods where specific PPIs or SPPIs are not collected.

Such indicators do not in general respect all four of the criteria for A methods.

C methods: The use of some other possible indicators, as follows, will usually be C methods.

- input methods (both input prices and input volume indicators) except for special unique products and where specific PPIs or SPPIs are available;
- secondary indicators, i.e. indicators not directly related to the output;
- PPIs, CPIs or volume indicators that do not correspond at all with the product(s) in question, e.g. the overall CPI.

Such indicators will, in general, fall a long way short of respecting the four criteria, much more so than the B methods do.

3.1.2. Non-market output

ESA 2010, paragraph 3.23, defines "non-market output" as that output that is provided free, or at prices that are not economically significant, to other units. This section only deals with the general issues of the volume measurement of non-market output. In chapter 4, the more specific issues related to the respective CPA sections, such as health, education and public administration will be discussed.

Non-market output can only be produced by non-market producers (local KAUs), that may or may not also produce some market output. The total value of output of a non-market producer is defined by convention as the total costs of production (i.e. the net operating surplus is assumed to be zero). In the case of a local KAU with secondary market output, non-market output is defined as a residual item, i.e. as the difference between the total costs of production minus the revenues from market output.

It is important to note that this valuation principle (calculating current price output as sum of costs) is applied to the *producer* rather than the product. Non-market producers are either public producers or non-profit institutions, classified in the sectors government or NPISH, respectively.

Non-market output can be subdivided into two types of output:

- individual goods and services: those that are consumed by individual households; and
- collective services: those that are provided simultaneously to the society as a whole (by definition, goods cannot be collective).

ESA 2010, paragraphs 3.101-3.108, defines the two categories more precisely, in fact partly based on convention. Examples of individual products are education, health, social security, recreation services and cultural services. Examples of collective services are general public administration, defence, police services and research and development.

3.1.2.1 Input, activity, output and outcome

The problem of measuring prices and volumes for non-market output arises from the fact that by definition no market prices exist. For that reason, the value of non-market output at current prices is defined as the sum of costs minus market output or output for own final use of the unit. Without prices for the output, there are only two options for volume measurement: deflating inputs and direct volume measurement.

Deflating inputs assumes that the change in the volume of inputs is representative of the change in the volume of output. Using this assumption makes it impossible to analyse changes in productivity, and will wrongly estimate the output change if this is different from the change in inputs.

Volume indicators can relate to:

- Inputs,

for example the number of employees. This would simply assume that twice as many government service employees would mean twice as much output, irrespective of how those additional personnel were deployed. The advantage of the method is the ease of implementation, and the ready availability of data. This method however ignores changes in productivity e.g. due to improved equipment (for example increased use of computers) or more efficient procedures.

A possibility would be to complement input methods with adjustments for changes in productivity. It is sometimes argued that any productivity adjustment is better than none. However, there is no reason why for example a 1% productivity adjustment would be more plausible than a 0% adjustment. Productivity might just as well have declined.

The problem is that such adjustments are inevitably based on assumptions, which cannot be verified without genuine measurement of the output. And if output could be measured, then input methods would not be necessary. Another problem is that there might be double counting of productivity changes, if the quality changes of the inputs (e.g. the labour) were already taken into account (see paragraph 3.1.2.3).

Another argument is that, even if input methods are not perfect, they could at least be the basis for comparable estimates for the Member States: if the same assumption about productivity is made in all countries, for example if all countries assume no change in productivity or all assume +0.5%. However, a harmonised assumption about productivity does nothing to make the resulting estimates of output more comparable. The more different the developments in productivity among Member States, the less comparable are the results from using the same productivity change assumption.

- Activity,

for example number of operations in hospitals or number of patrols carried out by the police over a month or a quarter. Such data can often be found. Activity indicators reflect what the non-market units are actually doing with their inputs and are therefore closer to output. However, suppose for example that new improved forms of medical treatment reduce the number of operations necessary. Taking the number of operations as an indicator would imply a decrease of output, which does not seem

appropriate in this case. However, for some collective services, activity indicators may be the only indicators of output that can be found.

- Output,

the preferred approach. However, it is not always easy to define exactly what the unit of output is. For individual goods and services it is in principle possible to define the output, since an actual delivery of that output takes place from the producer to the consumer(s) (see ESA 2010 paragraph 3.101). For example, for education, an output measure is the amount of teaching received by a pupil. For hospital services, an output measure is the amount of care received by a patient. For cultural services, an output measure is the number of theatre plays consumed. For collective services, however, there is no transaction between producer and consumer since the services are provided simultaneously to society as a whole. It becomes therefore very difficult to define the output. It is very difficult to say for example what the unit of output is of defence or police services.

- Outcome,

for example indicators of the level of education of the population, life expectancy, or level of crime. Such indicators can be influenced by factors that are unrelated to the activity, and are not representative of output. ESA2010 has rejected the outcome approach.

3.1.2.2 Output indicator methods

Suppose the output of a non-market producer can be described as the number of units of products produced. Then we get the following relations:

In current prices:

- number of units * unit costs = total costs = output in current prices

In volume terms:

- number of units * unit costs in the previous year = output in unit costs of the previous year

(For non-market products, the unit costs play the role of the price, see ESA 2010 paragraph 10.29.)

To measure output in current prices it suffices to calculate the total costs (i.e. no calculation of the number of units produced has to be made). However, output in volume terms (or in prices of the previous year) cannot be observed directly. In an output indicator method, the number of units produced and the unit costs in the previous year are estimated. In an input method, the output in unit costs of the

previous year is approximated by deflating the current year costs or extrapolating previous year costs.

The following criteria can be formulated for the appropriate use of output indicators:

- they should cover services produced by the producer that are provided to external users;
- they should be weighted by the costs of each type of output in the previous year;
- they should be defined at as detailed a level as possible;

These are requirements that are not easy to meet in practice. However, increasingly, governments are collecting output data for public services, typically starting with services to individuals such as health and education, because they need this information for good management and to assure taxpayers that resources are being efficiently and effectively deployed. Some data sources on outputs have been available for many years because they are required for administrative reasons (for example pupil and patient numbers, numbers of social security and tax cases handled).

Data collection for NPISHs is generally more difficult because of their small size and often reduced reporting requirements to government. Nevertheless data are available when NPISHs have to register with the government, and most NPISHs are required to keep accounts, even if these are less detailed than accounts for private businesses. Some countries undertake special surveys of NPISHs to gather data, and it is possible to use data from NPI satellite accounts, where they are prepared, to supplement the available data.

3.1.2.3 Taking quality changes into account

Taking quality changes into account for non-market output is not an easy task. In paragraph 2.4.2, general procedures for estimating quality adjustments were described. In many cases, such procedures use market prices to evaluate the quality differences between two products, since the market prices are supposed to reflect consumer preferences. For non-market output no market prices exist, making it very difficult to adjust for quality changes.

When output indicators are used, it was said above that these indicators should be defined as detailed and homogeneous as possible, especially with regard to their unit costs. With a detailed breakdown of outputs, structural changes within the aggregate output - which is part of the quality change - will be included in the volume estimate. For example, when health care output is subdivided into a large number of treatments, then shifts between treatments will be included in the volume component. In this case, a treatment with higher unit costs will implicitly be seen as a treatment of higher quality.

There are three approaches to adjust for quality changes:

- *Direct measurement of the quality of the output itself.* For example, a survey on the quality of public services could give indications of the changes in quality over time. For education, reports of school inspections could help. However, there are considerable difficulties. The information that is obtained can be subjective and may not be consistent over time or between units. Furthermore, there is a risk that the quality of the production process is evaluated rather than the quality of the output.
- *Measuring the quality of the inputs.* For example, compensation of employees could be estimated such that quality changes in the work force are included in the volume component. An assumption is then made that the quality change of the inputs leads automatically to a quality change of the output. However, this assumption cannot be verified without actually measuring the quality of the output.
- *Using outcomes.* The quality of the output lies in its results, i.e. in the outcome. For example, if the level of crime decreases, this could be due (probably in part) to improved effectiveness of the police. A practical problem with using outcome measures is that other external factors can also cause changes in outcome separately from changes in the direct output measures. For example rising levels of affluence in society may cause a decrease in crime.

For non-market output of individual services, given the conceptual difficulties and the absence of consensus on quality adjustment methods, adjusting direct output measures for quality is excluded from the central framework of ESA 2010 –see ESA 2010 paragraph 10.30:

“In the European Union, given the conceptual difficulties and the absence of consensus on output methods adjusted for quality (based on outcome), such methods are excluded from the central framework in order to preserve the comparability of the results. Such methods are reserved on an optional basis for supplementary tables, while continuing research.”

3.1.2.4 A, B and C methods

Individual services

For individual services, the preferred methods are those that measure output. Due to the difficulties to distinguish homogeneous products, input methods are allowed with one exception: for individual non-market education services, output measures without direct quality adjustment have to be used. They are specified in chapter (4.17)

For individual non-market health services, output measures without quality adjustment are recommended, if those indicators provide good coverage and are sufficiently

detailed. They are specified in chapter (4.18). For other individual services, input methods can be used.

For example: in the case of education support services, an output method without quality adjustment or an input method can be used.

An output indicator method is an A-method if the indicators satisfy the criteria formulated in section 3.1.2.2.

If the criteria are not fully satisfied, for example if the level of detail could be improved, the output method becomes a B method. The input method is a B method as well for all individual non-market services except for individual education services.

If a volume indicator method measures inputs rather than outputs, or if the coverage of the output is not representative, this method is a C method. An output method with direct quality adjustment is a C method. For individual education services an input method is a C method.

Collective services

For collective services, the classification of methods is broadly the same as for individual services. Due to the difficulty in defining the output of collective services:

- input methods are B methods for collective services;
- the use of volume indicators of activity is a B method.

The use of a single input volume indicator is not a B method: if input methods are used, they should estimate the volume of each input separately, taking quality changes of the inputs into account,, in particular of compensation of employees. No additional productivity or quality adjustments to the sum of the volume of quality-adjusted inputs should be applied.

For each category of inputs (intermediate consumption, other taxes and subsidies on production, compensation of employees, and consumption of fixed capital) recommendations on measurement methods are given elsewhere in the handbook.

3.2. Special topic: Products provided without charge to the user

The treatment of products provided without charge to the user is an interesting issue for measurement at both current and previous year's prices. The term 'free product' will be used in this section as a shorthand term for products provided without charge to the user. Free products are an extreme example of products where the cost is supported by the sale of other products, so that users do not pay a price that reflects the full costs of the product. Examples of these free products include:

- Computer software given away on electronic media or that can be downloaded from the internet without charge;
- Access to the internet through an internet service provider that does not charge directly for the service;
- Television and radio programmes provided without charge to the viewer; and
- Newspapers provided without charge to the reader.

However, these products are of course not provided free. They are funded by the support of others. The producer expects to recover the cost from others. This may be by selling advertising space that meets the cost or by taking a share in a distribution charge associated with the product. For example, an internet service provider may present advertisements on their webpages or receive an element of the telephone call charge paid by the user to the telecommunications provider.

Free products by their very nature are provided without charge to their consumers (be they households, government, NPISH or businesses). As such, they generate no final consumption expenditure and can therefore have no direct impact on GDP. However, transactions do actually take place and these need to be recorded somewhere in the system of national accounts. These transactions consist entirely of sales and purchases between businesses and, as such, should be recorded as intermediate consumption.

The application of appropriate price or volume indicators together with suitable indicators to ensure changes in quality are correctly taken into account are particularly important for the volume measurement of free products.

Let us consider the example of advertising sponsoring a free product, such as a newspaper. In this case, output at current prices will be generated from the value of the sale of advertising space within the newspaper. When constructing estimates at previous year's prices it then becomes necessary to apply price or volume indices to the output at current price. These price or volume indices must be appropriate to the output to which they are applied. In the example of the free newspaper, a price index would need to reflect the advertising rates charged by the newspaper and a volume indicator the quality and quantity of advertising space sold. It would be conceptually wrong to apply a price index that reflects the cover price of newspapers that are actually purchased, such as the CPI for newspapers. This is because the price development of the advertising space being sold is unlikely to be the same as that of the cover price of newspapers. A classification of methods appropriate for the measurement of price and volume for advertising is given in section 4.13.6.

The difficulty then comes in how to adequately reflect changes in the number of copies distributed or the quality of the free newspaper. As discussed above, the output of free

products (the advertising space) is used as intermediate consumption and therefore changes in quality or quantity can effect only intermediate consumption and have no impact on GDP (except perhaps for a part sold to non-resident businesses). Changes in the number of copies distributed can easily be interpreted as increases in the quality of the advertising service provided: the more people reached by the newspaper, the higher the quality of the advertising. If the newspaper improves its quality, e.g. by including more news or by the use of colour, the effectiveness of the newspaper as a communication source is enhanced which can be expected to again result in more readers and therefore a higher quality advertising service. Thus the number of readers could be used as an indication of the quality of the service provided.

Similarly, if access to the internet is provided without charge to the user and this is paid for through advertising, the output is the sale of advertising space rather than ISP subscriptions. In constructing price and volume measures it would therefore be important to ensure that changes in the number of active users of the free ISP were reflected adequately as improved quality of the advertising services produced. However, any change that comes from products other than the ISP should be reflected in those products, for example if improved quality phone lines gives improved access to the internet this should be reflected in the quality of the telecommunications service.

This leads to the general conclusion that for price or volume indicators to be considered appropriate for the correct measurement of free products, they need to be relevant to the product that supports the cost, usually advertising. However, the user of the free product can experience improvements in the quality of the free product. Also, the quantity of output of the free product can increase. In measuring prices and volumes of free products it is important to ensure that these improvements in quantity and quality are reflected if volumes are to be correctly measured. These improvements can only be recorded in the system in the output, and subsequent intermediate consumption, of the product from which the sales are generated. This results in changes in quality of free products being seen to impact on the productivity measure of the industries involved.

3.3. Intermediate consumption

Intermediate consumption includes the value of goods and services consumed as inputs by a production process (excluding the use of fixed assets). Deflating intermediate consumption is necessary when double deflation is used to measure value added in previous year's prices (see section 3.4), or more generally when price and volume measures are estimated in a system of supply and use tables.

Intermediate consumption consists of the use of domestically produced products and imported products. For both parts different price indices should be used, unless it can be assumed that the price changes of domestic output and imports are similar.

Intermediate consumption should be deflated product-by-product. This requires first of all a breakdown by product of intermediate consumption in current prices. This breakdown can be made in the use table. The advantage of employing the use table for this purpose is that intermediate consumption of all branches is described in the same product classification, so that the various deflators used for a particular product can be compared systematically (see also section 2.1). The total volume of intermediate consumption for each individual branch is derived by adding up the volumes of inputs of all products (this of course only works in a Laspeyres volume framework because this is additive).

Ideally, genuine price data on intermediate uses, collected from the purchasers (and reflecting purchasers' prices), should be used to deflate. Such data is rarely collected however. As an alternative, intermediate consumption of domestically produced products can be deflated using the same methods as described in chapter 4 for the output of that product, taking into account that intermediate consumption is valued at purchasers' prices (i.e. adding back changes in taxes and subsidies on products where appropriate). In doing so, differences in prices for different users should be taken into account. An example is electricity, for which large price discrimination can exist between different user branches. It is possible that quantity data exist for some products (for example the products of mining) and, subject to sufficient product detail and homogenous quality, this can be used to construct volume indices.

Intermediate use of imported products should be deflated by import price indices or the alternative methods described in section 3.9.

A, B and C methods

An A method for deflating intermediate consumption satisfies the following criteria:

- Deflation takes place product-by-product;
- Domestically produced products and imported products are deflated separately;
- Products are valued at purchaser prices;
- Either genuine price data on intermediate consumption are used, or, for domestically produced products, the A methods described in chapter 4 (taking into account the different valuation basis) and for imported products the A methods described in section 3.9;

B methods may fail to distinguish between domestic produce and imports, or they use methods that are classified as B methods in chapter 4 or section 3.9.

If intermediate consumption is deflated at the aggregate level, without product detail, this is a C method. Also, if deflation methods are used that are classified as C methods in chapter 4 or section 3.9, these are C methods for intermediate consumption as well.

3.4. Value added

Value added at current prices is defined as the difference between output (at basic prices) and intermediate consumption (at purchasers' prices). Value added is therefore a balancing item in the system of national accounts. There is conceptually no price or volume component of value added, since it is essentially an income concept. However, if GDP volume growth is calculated according to the production approach, the value added of all branches is summed (plus taxes less subsidies on products), so that it is necessary to have a measure of value added at previous year's prices.

Value added in volume terms has to be defined by convention. Paragraph 10.32 of ESA 2010 defines value added in volume terms as the difference between output in volume terms and intermediate consumption in volume terms. ESA 2010 subsequently states that "the theoretically correct method to calculate value added in volume terms is by double deflation, i.e. deflating separately the two flows of the production account (output and intermediate consumption) and calculating the balance of those two revalued flows.

The term "double deflation" might be better expressed as "double indicator method", since it also encompasses methods that are based on volume extrapolation. The essential point of double indicator methods is that separate, independent, estimates for the volume of output and intermediate consumption of an industry are made. The alternative is a "single indicator method" in which an output or input indicator is directly applied to value added. Single indicator methods use either (input or output) price indices to deflate current year value added or (input or output) volume indicators to extrapolate base year value added. In the first case it is assumed that prices of input and output develop in the same way, in the second case it is assumed that volumes of input and output are changing at the same pace, i.e. the ratio between volumes of input and output is constant. Single indicator methods are therefore not useful for analysing input/output ratios, for example for productivity analyses.

It is not possible to specify a preference within single indicator methods for deflation with price indices or for extrapolation with volume indices. This will depend on the quality of the data that can be obtained in practice.

Clearly, in a double indicator method the available indicators are put to a more appropriate use: to apply output or input indicators to value added directly is less appropriate than to apply them to output or input.

In practice, double indicator methods can create problems when intermediate consumption is a large share of output and the reliability of the price or volume data is not very high. In such cases, the estimate for the volume of value added can become erratic, and the use of a single indicator might become necessary.

A negative value for value added in volume terms is conceptually possible. See the following example:

	Intermediate consumption	Value added	Output
Value T	900	100	1000
<i>Price index</i>	<i>90</i>	<i>-210</i>	<i>105</i>
Volume T (prices T-1)	1000	-48	952
<i>Volume index</i>	<i>118</i>	<i>-95</i>	<i>106</i>
Value T-1	850	50	900

Although value added in current prices increased from 50 to 100, the ratio between the volumes of intermediate consumption and output has dropped significantly, showing a large decline in the input/output ratio (18% more input required to produce only 6% more output). At the same time, the prices of the inputs fell, while the price of the output increased.

Whilst these situations may be theoretically conceivable, it can be assumed that this will not happen very often in practice. If data like in the example were found in practice, there is good reason to check if the price and volume indices used are correct.

Another point to note is that, if double indicator methods are used, it can be proven that the resulting price and volume indices for value added are always outside the range spanned by the price and volume indices for intermediate consumption and output.

A, B and C methods

The A method for value added is the use of a double indicator method. The indicators used for output and intermediate consumption should follow the guidance given in sections 3.1 and 3.3 and chapter 4.

A single indicator method can be used as a B method if intermediate consumption is a large share of output and the data required to apply a double indicator method are not reliable enough.

3.5. Final consumption expenditure

3.5.1. Final consumption expenditure by households

Households are defined in par. 2.118 of ESA 2010. Final consumption expenditure of households is primarily made up of goods and services purchased in the market but also includes consumption of household production for own final use, such as the services of owner-occupied dwellings, and goods or services received as income in kind. It does not include social transfers in kind, intermediate consumption or gross capital formation, acquisitions of non-produced assets, payments to NPISHs, taxes other than taxes on products, or voluntary transfers (see par. 3.95 – 3.96 of ESA 2010)

The obvious approach to deflating the components of household final consumption is to draw upon detailed Consumer Price Indices (CPIs) since these are intended to show the change in consumer prices. Use of general indices (such as an all-items CPI or a cost of living index) is not recommended for the deflation of individual components of household expenditure. CPIs often follow national accounts concepts (for example in the distinction between consumption and capital formation, and in the separation of taxes from purchases of services). However there are usually a number of differences between CPIs and national accounts methodology that may need to be taken into account.

Countries may compile different types of CPIs for their own needs (and national accountants should be aware of the methods employed if these CPIs are used), but a harmonised standard is set for EU Member States by EU Regulations for the Harmonised Index of Consumer Prices (HICP). It is recommended for EU Member States that where suitable HICPs are available, these are drawn upon in compiling national accounts. There are, however some differences between HICP methods and the definitions required in the national accounts:

i) Differences of coverage

- *Consumption of own-produced goods and services.* These items are not included in the HICP definition of ‘final monetary consumption expenditure’ (the prices used in the HICP relate to monetary transactions only). The general rule here is that products produced for own-consumption should be valued at the prevailing basic price for equivalent products, or at costs of production if market prices are not available (par. 3.45 of ESA 2010). Where output for own final use is a significant part of total consumption of a certain product, it will be necessary to separately deflate it by a suitable basic price index; otherwise use of the HICP is appropriate.
- *Goods and services received as income in kind.* As with the point above, these items are excluded from the HICP calculation. Valuation of these products is at

basic prices if they are produced by the employer, and at market prices if the employer has to purchase them from a third party. If the former types of products are significant, then deflation should be undertaken using a suitable basic price index.

- *Goods and services purchased abroad by resident households.* The HICP covers all purchases made by resident and non-resident households on the economic territory of a country (see Regulation 1688/98 for more details). Household consumption in the national accounts covers the expenditure of resident households, including those purchases made abroad, but excludes the expenditure of tourists on the economic territory of the country which is covered by the HICPs. Within the Supply and Use Table framework, final consumption by product is normally compiled for total purchases made on domestic territory, with the net difference of purchases abroad and by non-residents domestically made as a global adjustment. If purchases abroad by residents form a significant proportion of total household consumption, and prices are evolving differently from domestic prices, then this should be reflected in the calculations of the volume series for the net adjustment – one method to undertake this could be to use the HICP data from another Member State to deflate expenditure abroad, adjusting for exchange rate changes if necessary and reflecting the different mix of products that travellers tend to purchase. Adjusting for exchange rates would imply that the effects of exchange rate movements feed through into prices fully and immediately.
- *Pension funding and life insurance services.* These should be measured as the changes in service charges implied by the difference between gross contributions/premiums (including supplementary contributions and premiums) and benefits, adjusted for changes in actuarial reserves. Life insurance services are excluded from the HICP and, because of the difficulties in separating life insurance from pension services, pension services will also be excluded.
- *Miscellaneous items* such as the service charges for lotteries and gambling, prostitution and narcotics are excluded from the HICP owing to the practical difficulties in price collection and measurement.

Where the HICP does not cover certain products, it will be necessary to examine other data sources. As a starting point, one should bear in mind potential differences between the COICOP/HICP and CPA classification systems, given that the CPA system is commonly used for producer and import/export price indices and volume measures. It is important to undertake the deflation at a sufficiently detailed product level, so that these potential classification difficulties are minimised.

ii) Differences in concepts

- *Services of owner-occupied dwellings.* These are a special case of the products for own consumption point above (and are defined in par. 3.75 of ESA 2010). They represent a high proportion of final consumption of households. The HICP compilers in Europe are currently investigating the possible use of house prices, but no decisions have yet been made. The recommended method for deflating this element in the national accounts is by a suitable index of actual rent levels (based on the methodology set out in Commission Decision 95/309/EC, Euratom) and this method is further described in section 4.12.2. The HICP contains a potentially useful series for “actual rents for housing”, although the weighting and survey methods used may differ from that set down in the Commission decision.
- *Non-life insurance services.* Regulation 1617/99 recommends a ‘representative pricing’ method for the HICP, based on gross premiums for policies whose “price-determining specifications” are kept constant. This is because the service charge on an individual level cannot in practice be obtained on a monthly basis. Section 4.11.2 of this handbook recommends that other methods be used for deflation of insurance services in the national accounts, since use of gross premiums is unlikely to be a good reflection of the changing price of the service charge.

iii) Differences of index number calculation

HICPs are Laspeyres-type indices. Technically, the deflators used in the national accounts for household consumption in the national accounts should be constructed on a Paasche basis, and therefore a re-calculation might be necessary to generate a Paasche-like index from HICP data. However, a Laspeyres-type index can potentially provide a reasonable approximation to a Paasche-type index if the index is calculated in sufficient detail (it is recommended that the reasonableness be tested in practice). The HICP legal framework sets out minimum standards for the compilation of sub-indices, requiring sufficient elementary aggregates to represent the diversity of items within each category of the COICOP/HICP and further requiring that sufficient prices are collected within each elementary aggregate to reflect price movements in the population.

It is essential that the price indices used should take proper account of changes in quality of products, to ensure that they are measured as a volume change. The HICP implementation Regulation defines quality change as arising from a change in specification of an existing product, which results in significantly different utility to the consumer, where a new variety or model of a good or a service replaces a good or

service previously selected for pricing in the HICP. The process of quality adjustment requires that replacement should in general be selected according to their similarity of utility to the consumer and not according to their similarity in price, where replacements have to be made after goods and services have been offered at reduced prices. Where no estimates for quality adjustments are available, the price changes are estimated as the difference in price between the selected substitute and the item it has replaced. (Council Regulation 1749/96 Article 2 paragraphs c and d, in conjunction with Article 5). Furthermore, this Regulation prohibits the estimation of quality change as the whole of the difference in price between two items, unless this can be justified as appropriate. It also encourages the timely addition of ‘newly significant’ products to the basket of goods, and the sufficient representativeness of products chosen for compiling elementary aggregates. All of these principles are consistent with the discussion of quality change in section 2.4 of this handbook.

A, B and C methods

Those methods based on deflation of household expenditure using appropriate CPIs are A methods. An index is appropriate if it:

- is an index of the price consumers pay for exactly that (group of) product(s);
- takes proper account of changes in the quality of products;
- is valued at purchasers’ prices including VAT;
- follows the same concepts as the national accounts.

Use of a CPI which does not meet all of the standards set out above is a B method. Where a detailed HICP or CPI is not available, B methods include the use of other indicators completely or partially covering the products in question – for example, PPIs adjusted for valuation differences, import/export prices, or volume indicators where these are available. The main reason why use of adjusted PPIs is not an A method is that they will generally cover products consumed by businesses as well as those consumed by households.

Any method using an index that does not correspond at all to the product in question is a C method.

The volume of services provided by persons employed in private households must be measured in the same way on the supply and on the use side. The method is explained in chapter 4.15.

3.5.2. Final consumption expenditure by government and NPISHs

The general government sector, defined in ESA 2010 (par 2.111), typically consists of institutional units producing both market and non-market goods and services. The treatment of production of market goods and services by government follows the same rules as for such production in other sectors (see section 3.1). The non-profit institutions serving households (NPISHs) sector is defined in par. 2.129 of ESA 2010 – the principles applied to this sector are similar to those applicable in the general government sector, so the two sectors are discussed together in this section.

By convention, the final consumption expenditure of general government and NPISHs consists of (ESA 2010 par 3.98):

- the value of non-market goods and services produced by government or NPISHs other than own-account capital formation and sales;
- purchases by general government and NPISHs of goods and services produced by market producers that are supplied, without any transformation, to households as social transfers in kind.

Final consumption expenditure consists of both individual and collective consumption (defined in ESA 2010 par. 3.101 – 3.102), whose value is measured by convention as the sum of costs – compensation to employees, intermediate consumption (including the cost of products purchased for social transfer in kind), consumption of fixed capital and other taxes less subsidies on production (ESA 2010 par. 3.49) – less any sales to households and other units.

ESA 2010 also identifies the concept of “actual final consumption” which, for general government, consists of collective consumption (ESA 2010 par 3.106). The actual final consumption of NPISHs is zero because they are assumed to produce only services to individuals.

Whilst the value of government and NPISHs final consumption is measured using an “input” approach, this does not mean that the only method for deriving volume data is to deflate the value of inputs by suitable deflators. In fact, other sections of the handbook (notably sections 3.1, 4.14 to 4.18) advise that there are suitable methods based on direct output indicators for individual consumption, such as “pupil hours” for education, “patient treatments by type” for health, and “members by type” for NPISHs. However output destined for collective consumption (especially those relating to ‘public administration’) presents more difficulties, and suitable deflation of the inputs may be the only viable option in many cases.

A, B and C methods

For a classification of A, B and C methods for non-market goods and services, see section 3.1.2.4.

For social transfers in kind consisting of goods or services purchased by government from the market, deflation by suitably detailed CPIs would be A methods if:

- allowance is made for any discounts which the Government may have negotiated directly with suppliers, and
- adjustments are introduced for any contributions which are payable by those receiving the transfers.

3.6. Gross fixed capital formation

Gross fixed capital formation (GFCF) covers both goods and intellectual property fixed assets. This represents a large range of different products, many of which can be unique, for example an oil rig, a specialised piece of plant and machinery, or intellectual property such as R&D services. The large range of different products calls for methods to be applied at a detailed product level to ensure good quality estimates of GFCF in volume terms. The general problem of unique products is discussed in section 2.5. Specific guidance on large equipment goods, computers, construction and R&D services can be found in sections 4.3.2, 4.3.3, 4.6 and 4.11 respectively. Computer software is also an important element within the category of intellectual property and specific guidance on its treatment can be found in section 4.11.

Like other categories of expenditure, GFCF can be measured from either the supply or demand side. However, the use of the supply side approach as the main measurement method is more frequent for GFCF because it presents a less resource intensive option compared to measuring GFCF independently from the demand side.

Measurement from the supply side uses data on domestic output less exports plus imports of capital goods at the product level. Product classifications are generally quite detailed, but still do not always allow the differentiation of products between those of a capital nature and those that should be considered intermediate or final consumption. This limitation needs to be kept in mind when considering methods for estimating prices and volumes from the supply side.

Measurement from the demand side uses data from purchasers of capital goods on the purchases they have made. The product classification of GFCF from the demand (consumption) side generally has limited product detail. For example, ESA 2010 provides a regrouping and coding for investment that, at its most detailed, is limited to only six products (AN_F6). Compiling volume estimates of GFCF at such a limited level of

detail is unlikely to produce high quality results, given the many different products and their unique nature. It therefore seems appropriate when considering the criteria for the classification of methods to provide further guidance on the minimum level of detail to be used.

Valuation is an important issue when considering the suitability of price indices for the deflation of GFCF. For price indices to be entirely appropriate they should measure changes in the purchasers' price of the particular products, including any non-deductible VAT included in the price. Price indices of this kind are often referred to as investment price indices. The direct use of PPIs, even if the product match is exact, can therefore be seen as not entirely suitable because PPIs are measured at basic prices. The use of PPIs for the deflation of GFCF would assume that the change in basic price and purchasers' price is the same, i.e. taxes, transport, installation and the other costs of ownership remain constant in volume terms.

Another important consideration is that some goods recorded as GFCF will have been imported. This creates the need to ensure a consistent approach to the deflation of products within imports and GFCF, taking account of any difference in price, for example due to taxes and subsidies on imports.

A, B and C methods

The use of genuine investment price indices (IPIs) for the deflation of GFCF will be an A method, providing they satisfy the following criteria:

- it is an index with a coverage of exactly that (group of) product(s);
- it takes proper account of changes in quality of the product(s);
- it is valued in purchasers' prices including non-deductible VAT; and
- the concepts underlying the index correspond to those of the national accounts.

The use of PPIs adjusted to purchasers' prices would also be an A method provided they satisfy the criteria described above for investment price indices.

The very different nature of the products covered within GFCF makes it unlikely that the criteria for an A method specified above will be satisfied for all products. This is particularly true for the criteria that coverage of the price index should be exact. Therefore when considering the criteria for B methods it seems sensible to specify a minimum level of product detail to be used in the deflation of GFCF. The significance of a particular product in its contribution to the total of GFCF also needs to be taken into account when considering the level of detail that should be used. IPIs, or PPIs adjusted to purchasers' prices, where the coverage is not exactly that of the products or that do not take account of changes in quality are a B method providing a minimum level of

product detail is available. This level of product detail should ideally be defined in terms of a recognised system of product classification, such as the CPA. However, this is not easy in practice because the CPA does not identify directly capital goods. Also in some areas, for example construction products, the CPA classification does not fit well with the actual assets that are transacted. An example of such a mismatch is dwellings. Dwellings are a clearly identifiable tangible asset, but they are not recognised directly within the product classification of the CPA. It is thus necessary to define the minimum level in terms of directly identifiable assets, some of which will link directly to the product classification in CPA.

The following list of products should be considered to be the minimum acceptable for a B method. If an item in the list does not make a significant contribution to GFCF, this item may be ignored. Anything more detailed than this breakdown would be considered an A method.

Code	GFCF by asset
AN.111	Dwellings
AN.112	Other buildings and structures
AN.1121	Buildings other than dwellings
AN.1122	Other structures
AN.113	Machinery and equipment
AN.1131	Transport equipment
AN.1132	ICT equipment
AN.11321	Computer hardware
AN.11322	Telecommunications equipment
AN.114	Weapons systems
AN.115	Cultivated biological resources
(AN.116	Costs of ownership transfer)
AN.117	Intellectual property products
AN.1171	Research and development
AN.1172	Mineral exploration and evaluation
AN.1173	Computer software and databases
AN.1174	Entertainment, literary or artistic originals
AN.1179	Other intellectual property products

The costs of ownership transfer of non-produced assets (AN.116) are treated as part of GFCF. However, the cost is included with the non-produced asset to which they refer and so are not shown separately in the balance sheet presentation.

Costs of ownership transfer include some business services (for example legal services) and taxes on products. The methods considered appropriate for these products, as

described in section 3.10 and 4.11, should also be applied to the measurement of price or volume of this component of GFCF.

Methods that do not reflect adequately the level of product detail suggested above are C methods.

3.7. Changes in inventories

3.7.1. Introduction

The calculations of changes in inventories (CI) at current and previous year's prices are often closely interlinked. If good current price estimates can be made because good data exist, then it is often possible to make good volume estimates as well, since the same data are used. Sometimes estimation at previous year's prices precedes estimation at current prices. Moreover, the estimation of CI is often linked to the estimation of other transaction categories such as output, intermediate consumption, etc. That means that a classification of estimation methods should also take the current price methodology into account.

In practice, the data available for the calculation of changes in inventories do not allow a 'perfect' estimation. Assumptions and approximations have to be made. The estimation methodology for CI (both at current and previous year's prices) is highly dependent on the kind of information on inventories that is available. This section will therefore be organised according to different data situations. First the ideal situation of full, perfect, information is described. It is necessary to consider this situation to be able to assess other methodologies against the ideal. Then the more realistic situation when information is only available on values of levels of inventories is described. Finally, the options for estimating CI at current and previous year's prices when no direct information is available at all are discussed.

Perhaps a rather obvious observation, but still worthwhile taking into account, is that volume-indices of CI are meaningless. Only price indices can be meaningfully calculated, and only for homogeneous products.

3.7.2. Some important definitions and relations

ESA 2010 defines CI as follows:

Changes in inventories are measured by the value of the entries into inventories less the value of withdrawals and the value of any recurrent losses of goods held in inventories.

The following types of inventories are distinguished:

- materials and supplies (AN.121)
- work-in-progress (AN.122)
- finished goods (AN.123)

- military inventories (AN.124)
- goods for resale (AN.125).

ESA 2010, par. 10.45, says the following about the estimation of volumes of inventories at the prices of the previous year:

10.45 Changes in inventories are measured by the value of entries to inventories less the value of withdrawals from inventories, and the value of any recurrent losses of goods held in inventories during a given period. Volumes at the prices of the previous year can be derived by the deflation of these components. In practice, however, it is rare for entries and withdrawals of stocks to be actually known, and often the only available information is the value of the stocks at the start and at the end of the period. In such cases, it will often be necessary to assume regular entries and withdrawals during the current period, so that the average price for the period can be considered relevant for both entries and withdrawals. In such circumstances calculating the variation in stocks by the difference between the values of the entries and withdrawals amounts to the same as calculating the difference between the values of the initial and final stocks. The variation in stocks in volume terms can then be calculated by deflating the initial and final stocks to bring them in line with the average price of the base period. When the variations in stocks are known in quantity terms, it is possible, again assuming regular entries and withdrawals, to calculate the volume of the variation in stocks by applying the average price of the base period to the variation in stocks in quantity terms.

Closely related to the calculation of changes in inventories are holding gains. Holding gains are the result of price changes during the period for which the inventory is held. Such gains are not part of output. Holding gains can be negative, in which case they are called holding losses. If there are no price changes during the accounting period, the holding gain is zero. Holding gains can be calculated using the following identity:

$$\begin{aligned} & \text{value of inventory at end of accounting period} \\ & \text{less value of inventory at beginning of accounting period} \\ & = \text{change in inventory} + \text{holding gains.} \end{aligned}$$

Other important identities are:

$$\begin{aligned} \text{output} &= \text{sales} + \text{CI of finished products} + \text{change in work-in-progress} \\ \text{intermediate consumption} &= \text{purchases} - \text{CI of materials and supplies.} \end{aligned}$$

For a wholesale or retail trader:

$$\text{output} = \text{sales} - \text{purchases (of goods for resale)} + \text{CI of goods for resale.}$$

(where changes in inventories are positive if the inventories are growing and negative otherwise). Enterprises usually report on sales and purchases rather than output and

intermediate consumption. Hence, the calculation of CI (and thus holding gains) goes hand-in-hand with the calculation of output and intermediate consumption.

3.7.3. If perfect information is available

Consider the estimation of CI of a certain product of a certain agent. In the ideal case, information is available on the exact times and quantities of additions to and withdrawals from the inventory and the price of the product at those times. Then it is in principle straightforward to calculate the CI at current and at previous year's prices. Additions and withdrawals have to be valued at the prices prevailing at the times at which they take place. The sum of all additions minus the sum of all withdrawals then gives the value of CI over the year. The mathematically correct method is therefore dependent on the path of prices and quantities in the course of the year. In practice, this calculation should be done on a monthly or quarterly basis. The annual value is the sum of CI in the months or quarters.

The CI at previous year's prices is calculated by valuing the quantities of additions and withdrawals at the average annual prices of the previous year, which are calculated by weighting with the changes in the quantities of the inventories in each month or quarter.

In a slightly less ideal world we will not have detailed information on additions and withdrawals, but only the levels of inventories (in quantities) at the beginning and end of the year. In this case, CI (both at current and previous year's prices) is calculated by multiplying the change in quantity with an average price of the year (current year or previous year, respectively). If the price of the product has been constant during the year, this provides an exact estimation. The same is true if the quantities do not change or change at a constant rate. If the price and the change in quantity have fluctuated, however, this method provides only an approximation of the ideal. The degree of fluctuation determines the accuracy of the approximation. The more prices or quantities vary during the year, the more necessary it becomes to calculate CI and holding gains on a quarterly or monthly basis.

3.7.4. If only information of values of inventories is available

In many cases, enterprises will not be able to give data on quantities, but only on the value of the level of their inventories at the beginning and end of the year according to their own bookkeeping system.

These bookkeeping systems generally do not value inventories according to ESA rules, but for example following historic cost system, LIFO system, etc.. Therefore, these values cannot be used directly in the national accounts. In this case, the change in volume has first to be derived, which can then be multiplied with an appropriate price index to arrive at CI at current prices.

In order to calculate correctly the change in volume of inventories, information is needed on the bookkeeping system used in the enterprise. Some countries ask this information in their production or inventory surveys. If no information is available, an assumption will have to be made. On the basis of the known or assumed bookkeeping system, the values of the levels of inventories can be deflated:

- if prices are available, then the values can be divided by these prices to obtain quantity information. The change in quantity then has to be multiplied with the average price of the desired year to obtain CI (at current or previous year's prices).
- If a price index is available that describes the price development of the stock according to the known or assumed bookkeeping practice, the values can be deflated to arrive at CI at previous year's prices directly. This should then be reflatd with an average price index according to national accounts valuation rules to determine CI at current prices.

The price indexes used should be in accordance with the kind of inventory in question. For inventories of finished products, PPIs at basic prices are the appropriate choice. For inventories of materials and supplies, similar indices as used for intermediate consumption should be used. These are preferably genuine intermediate consumption prices, but in practice mostly PPIs adjusted to purchasers' prices. For inventories of goods for resale a PPI will usually be a good indicator (for retailers, strictly speaking, a PPI should be adjusted for wholesale trade margins).

As regards work-in-progress, ESA 2010 gives clear rules on the valuation (see par. 3.148 and further). Deflation should obviously be carried out in a consistent way with the deflation of output, i.e. with output price indexes at basic prices. The problem here is that appropriate price indexes for the products concerned (e.g. large equipment, construction work) are often not available. See section 2.5 for a discussion of this problem.

Often only data on the total inventory are available, not by product. For inventories of finished products and work-in-progress, the assumption can be made that the data relate to the main product of the enterprise. For inventories of materials and supplies, it should be investigated which are the main inputs in the production process of which inventories are held. For inventories of goods for resale, assumptions have to be made on the basis of the main traded products.

3.7.5. If no information is available at all

The worst case scenario is when enterprises provide no information on values or quantities of levels or changes in inventories at all. In the absence of direct data, CI is usually estimated in an indirect way. CI is then calculated – for a particular product –

with the “commodity flow method” as the difference between total supply (output and imports) and total use (intermediate consumption, final consumption expenditure, gross fixed capital formation and exports). This procedure is flawed, since output and intermediate consumption can only be calculated *after* CI is known. The outcome of this method, therefore, will more likely reflect measurement errors in the various aggregates than the measurement of actual CI.

The use of this “residual” method should therefore be discouraged.

3.7.6. A, B and C methods

A true A method can only be achieved if good information is available from enterprises. This can be either direct quantity information or value information combined with knowledge about the bookkeeping system. Furthermore, appropriate price information is required (which does not necessarily have to come from enterprises in an inventory survey but could come from price statistics). Appropriate price indices are defined according to the general criteria specified in section 2.3. If prices and quantities vary considerably within the year, it becomes important to calculate CI and holding gains on a quarterly or monthly basis (either from information on additions and withdrawals or from levels at beginning and end of quarters or months), and calculate the annual total by summing the quarters or months.

If assumptions have to be made concerning the bookkeeping system, or if deflation is undertaken with less appropriate price indices, the calculation method becomes a B method. Less appropriate price indices are for example indices that do not exactly relate to the products in question, a consumer price index for the deflation of inventories of finished goods, etc.

If deflation of CI is carried out with proxy or inappropriate indicators then the method becomes a C method.

If CI of a product is calculated with the commodity flow method without resort to any direct data, this is also a C method. In the worst case, CI in previous year’s prices is calculated as a residual at the macro-level.

3.8. Acquisition less disposals of valuables

3.8.1. Introduction

Valuables contribute to GDP in two ways – the value added when they are first constructed, through the production account, and value added by traders of valuables through trade margins or commissions. Changes in their value during acquisitions and disposals are recorded as revaluation effect, which does not contribute to overall GDP. Nevertheless transfers of valuables between sectors do have an important influence on

sectoral aggregates, and the unique nature of valuables poses difficulties for valuing production in volume terms.

3.8.2. Some important definitions and relations

ESA 2010 defines valuables as follows:

3.154 Valuables are non-financial goods that are not used primarily for production or consumption, do not deteriorate (physically) over time under normal conditions and that are acquired and held primarily as stores of value.

The following 3 categories of valuables are identified:

- Precious metals and stones.
- Antiques and other art objects.
- Other valuables (for example jewellery and collector's items).

ESA 2010, par. 3.157, says that production of valuables should be valued at basic prices. All acquisitions of valuables should be valued at purchasers' prices, including agents' fees or commissions and dealers' trade margins. Disposals of valuables are valued at prices received by sellers - that is, after deduction of fees and commissions.

There are two different ways of looking at the concept of a "volume of valuables". The first is to consider them as a store of purchasing power for the holder, which implies that the volume should be measured as the change in value of the valuable divided by some general purchasers' price index. The second way of considering valuables is that they are products in themselves, and therefore the appropriate approach to measuring the volume is to deflate by a specific price index for the valuable concerned. The recommended approach, and the one described in this section, is the second approach because we are concerned here with the narrow concept of production and trade in the valuables themselves (in much the same way as we measure the volume of expenditure on capital items by observed prices for these items, rather than using a "productive potential" approach).

3.8.3. Different types of transaction

It is important to distinguish between the different transactions that can involve valuables, since they pose different challenges for expressing flows in volume terms.

The creation of valuables through production is valued at basic prices, which can obviously change as costs, margins, and consumer tastes evolve. The key challenge to valuing these flows in volume terms is that the products involved are generally *unique* or available in only very limited quantities (for example a painting is unique, whereas there might be several examples of an antique manufactured good in very similar condition). This is compounded by the fact that the quality of valuables is very difficult

to define – for most people it will be some intrinsic artistic quality (where judgement might vary quite widely), whilst for others it will be the potential gain in value over time.

The issue of unique goods is discussed in section 2.5, and with reference to large equipment and construction in sections 4.3.2 and 4.6 respectively. There are several options available – product decomposition into the constituent elements (perhaps possible for a piece of jewellery, but hardly viable for a painting), comparison with a similar piece sold domestically or in another country (the common method for initial valuation by experts in “the trade”), and deflation of the costs of inputs.

Expressing the trade of existing valuables in volume terms suffers from the unique goods and quality measurement problems. Nevertheless there may be more that can be done – the individual product has probably been sold before (although it may be many periods before) which could allow an interpolation method to be employed, or the product may be one of a series of closely related products (eg. paintings by the same artist during a certain ‘period’).

For traders and dealers in existing valuables, the principles set out in section 4.12.1 for handling real estate agents’ fees may well be appropriate – since commissions for mediating transactions are often based on a percentage of the value of the article(s), a suitable price index for deflating turnover would follow both the percentage and price of the traded valuable(s). Auctioneers are classified in CPA 69.10 Legal services. Museums and art galleries are in CPA 91.0 These services will not be in acquisitions less disposals of valuables.

Finally, the margins of traders/dealers in newly produced valuables can sometimes be measured separately (for example in the jewellery trade) and the methods set out in section 4.7.1 (wholesale and retail trade margins) applied as appropriate.

3.8.4. A, B and C methods

The A method applicable to production of valuables is if there is a suitable PPI for an industry producing valuables, which is adjusted properly for changes in quality (this may be possible for the jewellery industry for example). For some types of valuables, a model or specification pricing approach could be an A method if it meets the criteria set out in section 2.5.

For services on a fee basis, where the fee is a percentage of a value of the articles handled, a proper price index would combine the change in fee percentages and the change in worth of (that particular subset of) valuables. This would constitute an A method.

B methods for measuring volume flows for production of valuables are comparison with closely related products (either domestically or internationally) such as a painting by the

same painter, and decomposition into constituent elements (more suitable for jewellery and complex products).

B methods for measuring volume commissions or trade margins could be the use of an index based on worth of valuables. Since mediation fees for valuables are often percentages of the worth of the valuables it is reasonable to think that both are correlated enough to constitute a B method. It is then implicitly assumed that the fee percentage is constant.

Less good, but still a B method, is the use of numbers of units of valuables traded, broken down by type. This is more appropriate for more homogenous products.

3.9. Exports and imports of goods and services

3.9.1. Introduction

Exports and imports are an important element of the national accounts that require careful treatment in the measurement of prices and volumes. This is especially true within an input-output framework that requires a consistent approach to deflation of exports and imports to be used. For example, exported products appear as output in the supply table and as exports in the use table, imports on the other hand appear as intermediate or final consumption in the use table and as imports in the supply table. Although the valuation basis in the separate supply and use tables is different, ie basic and purchasers prices respectively, the need to ensure consistency remains if the tables are to balance.

Transport costs are an important element of exports and imports. Transport products are covered in section 4.8. Imports and exports of products are recorded at border values. Total imports and exports are valued at the exporter's customs frontier, referred to as free on board (f.o.b.). Foreign transport and insurance services between the importer's and the exporter's frontiers should not be included in the value of goods, but recorded as services. However, it is not always possible to obtain f.o.b. values at the detailed product level and details of foreign trade are then shown valued at the importer's frontier. In this case, all transport and insurance services to the importer's frontier are included in the value of imports, referred to as cost, insurance and freight (c.i.f.). This is the valuation used for imports in the supply and use tables. Where the price of exports and imports includes an element of transport or insurance service, these need to be dealt with correctly in the price and volume measures. Import price indices, where available, will usually be on the basis of the cif valuation. As such, when they are used for the deflation of imports on a cif valuation in the supply and use table this represents the correct method. However, it is then necessary to apply a global adjustment within the supply and use table to correct imports from a c.i.f. valuation to the required f.o.b. basis. This adjustment requires deflation for the compilation of supply and use tables at previous year's prices. A suitable price index for the deflation

of this c.i.f./f.o.b. adjustment would need to take account of the price development of transport and insurance services for imported goods. These price developments are likely to be different for different products being imported for different countries. In constructing price indices better quality results are likely to be achieved as the level of detail used increases. However, in practice it may not be possible to obtain detailed prices by product and importing country or to find suitable weights to allow them to be combined. In these circumstances price indices for transport and insurance services by country offer an acceptable alternative.

When considering methods appropriate for the measurement of prices and volumes it is useful to consider goods and services separately.

ESA2010 has introduced new approaches for goods for processing and merchanting.

Under ESA 2010, goods sent abroad for processing are recorded on a strict change of ownership basis, meaning that where goods sent abroad do not change ownership, they are excluded from the trade in goods data. Instead, the cost of the **processing service** is recorded as trade in services (*manufacturing services on physical inputs owned by others*).

Merchanting occurs when merchants or commodity dealers buy from non-residents and then sell again to non-residents. According to ESA2010 purchases and sales of merchant goods are recorded under exports. Purchases are shown as negative exports. If they are not sold in the same accounting period the negative exports are balanced by an increase in inventories of goods for resale. Goods under merchanting should be separately identified by either national accounts or balance of payments enterprise surveys of merchants and deflated using export and import price indices for the products purchased and sold under merchanting.

3.9.2. Goods

There are a number of methods that are potentially suitable for the estimation of goods. These are:

- Actual export and import prices
- Unit value indices (UVIs)
- Adjusted PPIs, and
- Export prices of a foreign country.

Actual prices, UVIs and adjusted PPIs are potentially suitable methods for both exports and imports. Export prices of a foreign country are only really suitable for consideration for imports. The remainder of this section will consider each potential method in turn

and assess the advantages and disadvantages. A more general discussion of the usefulness of price indices and unit values can be found in section 2.6.

Actual export and import prices

Export and import price indices can be compiled based on the prices actually charged by exporters of goods, in the case of exports, or paid by consumers, in the case of imports. Prices have the advantage that they cope better with the problem of heterogeneous products as the price index is constructed to reflect a fixed specification that allows price effects to be isolated and quality changes to be controlled. However, this can result in incomplete coverage of the actual exports and imports of products to which they are applied as deflators. Price indices are costly to produce and represent a burden on respondents. Price indices may also reflect inadequately the actual prices paid by purchasers. This may be an important factor for export and import prices where the use of forward contracts and currency hedging instruments may mask the actual prices paid.

Unit value indices (UVIs)

UVIs are readily available from trade statistics being derived as the ratio of value to volume (weight or quantity). They do not generally control for changes in the product mix within one item, leading to quality changes mistakenly included in the price component. Their coverage of products is generally complete, but even at the most detailed level of trade classification can often include a range of different products. Where the products within an item of the trade classification may appear to be homogeneous this may in reality not be the case as products of similar description may be of very different quality. It may be possible to construct more homogeneous UVIs if the country of origin (or destination) is also taken into account. UVIs are clearly unsuitable for products that are unique or change quickly in specification.

Adjusted PPIs

It is also possible to use domestic PPIs to deflate current price estimates for exports and imports in the same way as actual export and import prices may be used. PPIs reflect prices on the domestic market and may not be a good reflection of the prices charged for exports or imports in some circumstances, for example luxury goods, where competition between domestically produced products and imports is of minimal importance and has little impact on price. However, there may be little difference between domestic prices and those of imports or exports where these compete directly with each other in the market. In these conditions, the use of PPIs for exports or imports may be acceptable.

A way of improving the domestic PPIs to make them more representative of exports and imports would be to adjust them in some way to reflect better the actual export and import prices. Such an adjustment could be made in a number of ways.

The most simple would be to take account of exchange rate movements between the domestic currency and that of the countries to which the exports are going to or the imports coming from. Such an approach is based on the assumption that movements in export and import prices differ from domestic price movements only in respect of movements in the exchange rate.

A more complex approach could be to derive an adjustment factor based on some other variable, for example, UVIs. The adjustment factor could be derived as follows. First, select a group of products that have stable UVIs and construct an overall UVI for this group of products. Second, construct an overall PPI with the same coverage of products as that used for the overall UVI. The final stage is to derive the ratio of these two indices. This ratio is then applied to a PPI that represents a range of products present in the export or import estimates for which other more suitable price or volume indicators are not available. In this way the resulting adjusted PPI is based on the price movements exhibited in the UVI, but without the volatility of some of the products. The aim of this approach is to reduce the various shortcomings of UVIs by using a wide mix of products. If some actual export and import prices are available a similar method for adjusting the PPIs could be used, but using the actual prices in place of the UVIs.

Adjusted export prices from foreign countries

In this approach the export prices from a foreign country are used to deflate imports. Imports need to be broken down by product group and country to make best use of this method. Such an approach is most suited to unique products of a specialised nature and this is considered further in section 2.5 on unique products. Adjustments may be necessary to account for exchange rate movements, on the assumption that movements in exchange rates impact directly and immediately on the price of the imports. To further improve this method, additional adjustments that take account of other factors that affect prices between the exporting and importing countries, such as transport margins, can be made.

A, B and C methods

In striking a balance between the cost of price indices and the availability of UVIs, the suitability of the existing UVIs could be explored first. Comparisons of UVIs and price indices for Germany, Denmark and The Netherlands have shown the two methods give significantly different results. Based on these comparisons, it has not been possible to clearly identify types of products where these differences are limited, making UVIs acceptable. This is not unexpected, as the comparisons have been carried out at a high

level where problems of heterogeneous products present themselves. However, the use of UVIs for some products is clearly inappropriate. These include products of a unique nature where price methods (for example, model or specification pricing) should always be used. Price methods may also be more appropriate than UVIs for capital goods.

A methods should be based on the use of quality adjusted price indices for all exports and imports. The price indices should be consistent with the product classification used in the value data being deflated. Their valuation should correspond to the valuation used for the current price data, i.e. f.o.b. for exports and either f.o.b. or c.i.f. for imports.

Deflation with price indices that do not adequately reflect changes in quality should be considered B methods.

For product groups that are sufficiently homogeneous over time, UVIs can also be considered B methods. The volatility of the UVIs should be examined as a test for suitability rather than simply relying on the understanding of the content of any particular trade group.

The suitability of PPIs, whether adjusted in some way or not, needs to be assessed on a case by case basis before they can be considered appropriate. First of all, the coverage of the indices used should be appropriate. Where prices on the domestic and import market are similar, because of competition, then the direct use of PPIs can be considered as suitable, as there will be little difference in price. Where market conditions are such that domestic prices do not reflect adequately the price of imported or exported goods then PPIs will need to be adjusted to reflect these differences before they can be considered suitable as B methods. If movements in the exchange rate are the only factor that influence export or import prices then PPIs would need to be adjusted for this to be considered a B method. Where other factors influence prices then more complex adjustments to the PPI would be necessary before they can be considered suitable. The usefulness of the method relies on the fact that the less representative the adjustment factor to the total the lower in quality will be the result.

The use of foreign country export prices for the deflation of imports is a B method where the coverage of the product is exact and adjustment for the different changes in prices between the two countries has been made. This method is considered in more detail in section 4.3.2 on large equipment.

All other methods should be considered C methods. This would include the use of UVIs for insufficiently homogeneous product groups and input methods (except for special unique products for which input methods are appropriate).

3.9.3. Services

Exports and imports of services consist of a large range of different services. The estimation of prices and volumes for exports and imports of services is an area where existing methods are less well developed. This is not unexpected considering methods for domestically produced services are also less well developed. It seems sensible when making proposals for the classification of methods for export and imports of services that these should be guided by those recommendations for similar domestically produced or consumed services. The classification of methods to be used for domestically produced services is included in chapter 4 of this handbook.

Apart from a few particular types of services, generally, actual price indices are the preferred method for deflation. For exports and imports, these prices need to reflect the actual prices charged in the case of exports and the prices paid for imports. These prices will differ from those in the domestic market because of exchange rate influences and potentially different pricing policies in the case of domestic and export sales. A further difficulty associated with the collection of export and import prices is the identification of the sampling frame necessary for the collection of prices.

Cross-border consumption, i.e. expenditure by non-resident individuals or governments on the domestic territory and the expenditure of resident individuals or governments whilst abroad, is one element of exports and imports of services that is not covered in the sections on domestically produced services. Examples of cross-border consumption include the holiday and business expenditures of residents outside their domestic territory, the expenditures of governments on embassies and military units overseas. Cross-border transactions will be considered separately in the following classification of methods for exports and imports of services.

A, B and C methods

Detailed recommendations on the classification of methods for domestically produced services are made in chapter 4 and these will not be repeated here. Appropriate methods for the estimation of prices and volumes for exports and imports of services should simply reflect those methods. However, where price indices have been recommended these should reflect the actual export or import prices paid when these are used for the deflation of exports and imports of services.

For the expenditure of non-residents (either individuals or governments) on the domestic territory these should be deflated using CPIs consistent with the range of products that are purchased by non-residents for this to be an A method. If CPIs that have a narrower or wider coverage of products than those purchased by non-residents are used, this would be a B method. It may be necessary to make some adjustment for taxes for tourists from countries outside of the EC as they can claim back the VAT they

have paid on their purchases. If CPIs are used in these circumstances they may need to be adjusted to reflect these tax free prices, if tax rates change over time.

For the expenditure of domestic residents abroad (individuals or government), the use of detailed and appropriate CPIs for the country visited, adjusted for exchange rates, would be an A method. The use of foreign country CPIs that have a wider or narrower coverage would be a B method.

Processing can be classified according to the Standard Industrial Activity (SIC2007) of the goods being processed eg clothing products, petroleum products, computer products. If it can be assumed that prices charged for each processing activity move in line with the Producer Price Index (PPI) for that manufacturing activity, the PPI can be used as the deflator. This would be an A method. If the PPI for the manufacturing activity is not appropriate and information about the service price is not available input methods may be used. This would be a B method. Processing on behalf of domestic clients can use the same approach as for non-resident clients.

Goods sent abroad for processing (imports of manufacturing services) should be deflated by the relevant manufacturing service PPI in the economy in which the processing takes place. As processing is likely to take place in several countries for many different manufacturing services, an A method would be to weight the PPIs in line with the value of the processing services provided by each country. If such detailed data is not available, a B method would be to use the aggregate manufacturing PPI from the main country to which goods are sent abroad for processing (from trade in services or IMTS statistics) to deflate imports of manufacturing services. It will also be necessary to adjust for exchange rate movements, if the processing fees are priced in a foreign currency.

Any measure using deflation of inputs is considered a C method (except for unique services such as R&D).

3.10. Taxes and subsidies on products

Taxes and subsidies on products play an important role in an integrated system of price and volume measures as being (part of) the difference between the basic price of a product and its purchasers' price. This has been discussed in section 2.1. For an individual product, output should be deflated by a price index in basic prices and consumption should be deflated by a price index in purchasers' prices. In this process, the way prices and volumes of taxes and subsidies on products are defined is important.

The category 'taxes and subsidies on products' includes taxes and subsidies on imports. As with other taxes and subsidies, taxes less subsidies on imports are added to the total of gross value added at basic prices to obtain GDP from the output approach. This means that any change in the application of taxes and subsidies across products can

potentially have an impact on the overall estimate of GDP, at both current prices and in volume terms. Consequently, it is important that the methods described below are applied at the detailed level of taxes.

Taxes and subsidies on products may be of two basic forms – based on the value of products (known as ‘ad valorem’) or based on the quantity of products. Within the ad valorem category, VAT is a special case.

One should note that in the discussion and examples, it is assumed that there is a single rate of tax for each product. In practice, there may be different rates of tax or subsidy applicable to a particular product, depending on the use to which that product is put (whether for intermediate consumption, final domestic use, or export), whether or not the product benefits from an exemption, and (for a small number of cases in VAT) the specific business consumer. It is important that this is factored into the calculations where it occurs, by disaggregating the data sufficiently between uses.

3.10.1. Taxes and subsidies related to quantities of products

The concept of volume is relatively easy to understand for a tax levied on a quantity of products. Tax revenue is simply derived by multiplying the relevant tax rate and the quantity of the goods, which are subject to the tax (volume of the tax base). The volume of the tax can be calculated by applying the tax rate prevailing in the base year to the volume of products in the current year. This idea of volume of tax is in line with the Laspeyres philosophy. It implies that the volume index of the tax is equal to the volume index of the product (which should - at the level of individual products - be equal in basic prices and purchasers' prices).

If a new tax is introduced, or the scope of a tax is extended to include more products, the above Laspeyres methodology implies that this is recorded as a price effect rather than a volume effect, as is illustrated by the following example.

	Product A		Product B		Total tax revenue
	Quantity	Tax rate per unit	Quantity	Tax rate per unit	
Year T-1	100	10	200	0	1000
Year T	100	10	180	10	2800

The total tax revenue has increased by 180% between year T-1 and year T, caused entirely by the extension of the tax to product B. In this case, because the tax rates of year T-1 are applied to the quantities of year T the volume measure of the tax remains unchanged and the entire rise in tax revenue is attributed to a price effect (ie. the tax-

price has risen by 180%). This is equivalent to saying that the tax for users of the products has increased – before they had a tax-free product, now they have to pay tax.

An alternative scenario to consider here is the introduction of a new product, which is subject to a common product tax of 10 per unit. An example follows:

	Product A		Product B		Total tax revenue
	Quantity	Tax rate per unit	Quantity	Tax rate per unit	
Year T-1	100	10	-	-	1000
Year T	100	10	180	10	2800

As in the first example, the tax revenue has increased by 180%. In this case however the rise in tax revenue should be entirely attributed to a volume effect. This is because treatment of new products for taxes and subsidies is analogous to the more general treatment of new products set out in section 2.4, where a specific price change is inferred (from the overlap or other method) or the products' prices are assumed to develop in an average way (the re-sampling method). In either case, this means that a tax rate is inferred in period T-1 for product B in the example, and since this tax rate remains unchanged between T-1 and T, the rise in tax revenue is viewed as a volume effect.

Where a product disappears, an analogous situation can be foreseen. An assumption is made for the development of the tax-price of the product and this is reflected (where the tax-price is assumed not to change) in the entire tax revenue effect being viewed as a (negative) volume change. Thus the replacement of one product by an equal quantity of another product leads to offsetting effects on the volume of the tax or the subsidy, which therefore remains unchanged.

3.10.2. Taxes and subsidies related to values of products

Taxes and subsidies levied on value of products are slightly more difficult to work with. The underlying volume concept is the same as above, but the price of the good is a complicating factor. An example will serve to illustrate the point (this is equally applicable to subsidies):

	Quantity	Price	Tax rate per monetary unit	Total tax revenue
Year T-1	100	10	20%	200
Year T	120	12	25%	360

The value of the tax yield has increased by 80% as a result of changes in each of the determining variables. The volume change is only 20% – at a constant “taxation price” (where “taxation price” represents the combined effect of tax rate and price, a 50% increase between the years). Turning this calculation on its head, the volume change can be derived by dividing the value change by the taxation price change (in index format, 180 divided by 150). Undertaking this calculation across many products means that the volume measure is a weighted combination of changes in the volume of products based on weights derived from the taxation price rates that apply to each product.

VAT is a special case in that it is deductible when products are used for intermediate consumption (by non-exempt units), exempt for products that are specifically identified as non-deductible (in the EU, those activities covered by the Sixth VAT Directive). The same general principles apply as above -derive a taxation price index to deflate total value of taxes, and all changes to the tax code specifying products covered by VAT should be recorded as a taxation price change. However, when calculating the volume element of VAT, it is important to bear in mind the distinction between deductible and non-deductible VAT. An example will serve to illustrate this.

	Output (basic prices)			VAT	Intermediate consumption (purchasers' price excl. VAT)			Household consumption (purchaser's price incl. VAT)			Total use
	Quantity	Price	Value		Quantity	Price	Value	Quantity	Price	Value	
Year T	200	20	4000	400	100	20	2000	100	24	2400	4400
<i>Price index</i>		<i>100</i>	<i>100</i>	<i>100</i>		<i>100</i>	<i>100</i>		<i>100</i>	<i>100</i>	<i>100</i>
Year T in prices of T-1	200	20	4000	400	100	20	2000	100	24	2400	4400
<i>Volume index</i>	<i>100</i>		<i>100</i>	<i>200</i>	<i>67</i>		<i>67</i>	<i>200</i>		<i>200</i>	<i>105</i>
Year T-1	200	20	4000	200	150	20	3000	50	24	1200	4200

Assume that in year T, 200 units of product A are produced, and 150 units are sold to other industries for a price of €20 (that is without VAT), whilst 50 units are sold to

households for a price of €24 (that is, including VAT at an assumed 20% rate). Total VAT revenue from product A is €200.

In year T+1, the VAT rate remains unchanged at 20%, and 200 units of product A are again produced. But this time 100 units are sold to other industries and 100 units sold to households. Total VAT revenue from product A is now €400, an increase of 100% over the previous year.

In this example, the full 100% change in VAT revenue is considered as a volume effect. No prices have changed, and therefore the increase in VAT collected is caused solely by an increase in the quantity of goods subject to VAT (caused by a change in the pattern of consumption). By analogy with the general principles set out above, this represents a volume change.

Similarly, one can note that a change in the balance of products for export (not subject to VAT) and for home consumption will also lead to a change in the total tax collected, and a volume change of the tax, even if the quantity of products produced has not changed.

Both of these examples are an illustration of the general point discussed towards the start of this section – one should undertake the calculations at the highest possible level of detail in order to capture within the taxation price effect any variations in tax rates determined by the use to which a product is put.

3.10.3. Collection rate issues

Finally one should consider the difference between theoretical and actual tax revenues. For the example of a particular product subject to a value tax, the value of the product multiplied by the prevailing tax rate will often be greater than the actual tax revenue stream, because the tax system is rarely 100% successful at collecting all possible revenues. This is equivalent to adding a further variable to the calculation:

$$\text{Actual Tax Revenue} = \text{Quantity} \times \text{Price} \times \text{Tax Rate} \times \text{Collection Rate}$$

It is important to decide where the collection rate effect should be recorded – whether a volume or a taxation price effect. It may be argued that the collection rate is actually analogous to the tax rate (that is, comprehensiveness of collection is under the control of the Government in the same way that the tax rate is) and therefore it should be included as part of the taxation price effect. The collection rate for any particular product can be readily calculated as the ratio between actual and theoretical tax revenue.

There is a particular point to consider here when calculating the volume element of VAT. The current price measure of VAT in the EU includes amounts that are not actually collected where the non-collection was caused ‘without complicity’ between the

transacting parties (Commission Decision 98/527/EC). Applying this definition to the calculation of prices and volumes, the ‘collection rate’ must relate to the “with complicity” element of uncollected VAT.

3.10.4. A, B and C methods

The principles set down in ESA 2010 par. 10.36 – 10.41 (and summarised above) for taxes and subsidies on products are A methods provided that variations in the collection ratio of taxes and the coverage of taxes and subsidies are both included in the taxation price effect and not the volume effect.

If different taxes or subsidies are not fully separable (for example two different taxes are set on a particular product but there is no separate information available on each) then the methods described above become C methods because this would mean that the price and volume elements of taxes would not be correctly separated.

3.11. Components of value added

In section 2.1 it was stated that the income approach cannot be used for measuring GDP volume growth, since income components do not have underlying price and volume concepts. Nevertheless, in certain cases, it can be necessary to calculate the components of value added in volume terms. This is for example the case when input methods are used for unique market or non-market output. Also, measures of the volume of labour input can be demanded. Therefore, and for reasons of completeness, the next three sections discuss the possibilities of measuring components of value added in volume terms.

3.11.1. Other taxes and subsidies on production

“Other taxes and subsidies on production” are defined in paragraphs 4.22-4.24 and 4.36-4.40 of ESA 2010. Taxes and subsidies on production are one of the determinants of the basic price of a product.

Taxes on production consist of all taxes incurred by enterprises which are not directly related to the quantity or value of products produced or sold. Examples include taxes on the payroll of enterprises (but not taxes paid by employees), taxes on pollution, licences where there is no service element, and taxes on the use of vehicles and land.

Subsidies on production, similarly, are not linked to the number of units of production (that is, they are not intended to reduce prices to the consumer) but, like taxes, they are intended to change the behaviour of the firm in the way that it employs its inputs or undertakes the production process; for example, subsidies to reduce pollution.

Importantly, both taxes and subsidies on production should be recorded at the time at which the underlying activity is taking place. This also means that the price and volume calculations should be recorded in this way, not when the taxes are paid.

The major conceptual difficulty with deriving a volume of taxes and subsidies on production is that, unlike for taxes and subsidies on products (discussed in section 3.10), there is no single quantifiable determining factor for the “tax/subsidy base”. It is therefore important to draw out the underlying equivalents for the “tax/subsidy base” for each type of tax and subsidy on production – in each case there will probably be specific criteria written into legislation. For example:

- Payroll taxes – These might for example be levied on the total number of employees or the total salary bill. In the former case, an index of total number of employees covered by the tax would be a suitable volume measure. Where the taxes are levied as a percentage of salary bill, an adjustment should be made to the volume calculation for the underlying wage rate changes (which are a price effect). Further discussion of the deflation of compensation of employees can be found in section 3.53.11.2.
- Taxes on ownership or use of an asset – These might be levied on the number and/or size of assets used (for example cars, property). As with payroll taxes, where the tax is levied on a value of assets, the changes in the unit price of the asset should be measured as a price effect. Further discussion of the deflation of capital expenditure and assets can be found in section 3.6.
- Taxes in the form of licences – In line with ESA 2010 principles, licences are considered a tax if there is no service provided. Licences are often levied as a flat rate on the businesses affected, and therefore the number of business units subject to the licence requirement can be seen as the underlying volume measure.
- Subsidies on certain processes (eg. those reducing pollution) – Subsidies may be administered in a number of different ways: as a flat rate per qualifying firm, as a reimbursement for certain types of expenditure, or in proportion to a firm’s size of turnover. Where there is a flat rate system, the number of qualifying firms would form the basis of a volume measure. For a reimbursement system, a suitable measure would be the volume of goods or services reimbursed.

For those taxes or subsidies related to a production process or ownership of an asset, or restricted to selected firms, it is unlikely that complete volume data can be collected from the firms concerned. It would be more straightforward to examine the administrative records of the Government authority concerned to determine the tax/subsidy base on which the payments are based (though care must be taken to ensure that the records are complete and allow the calculation of accrued rather than cash measures). For “per unit” taxes and subsidies (eg. per firm, per quantity of assets), the Government records may yield the necessary information directly, or units can be

calculated by dividing the total values by the tax/subsidy rate. It is important to use the greatest possible detail for these calculations.

A, B and C methods

A methods will be based on complete and accrued data, with each individual tax or subsidy examined and treated separately, and will use an appropriate index for deflation (based on the recommendations in other sections of this handbook) where the tax/subsidy is based on a value of assets, goods or services.

B methods are used where:

- it is not possible to separate taxes and subsidies fully by their underlying tax/subsidy base, or
- where the indices used for deflation do not meet the standards required in other sections of this handbook for A methods.

In practice it is very unlikely that a method based on collecting volume data from a direct survey of firms paying and receiving taxes and subsidies will be sufficiently comprehensive to reach the necessary coverage for a B method.

3.11.2. Compensation of employees

“Compensation of employees” is defined in paragraph 4.02 of ESA 2010. It is important to note that this category includes wages and salaries and social contributions, and that monetary flows are imputed for wages and salaries in kind, and for certain employers’ social contributions. One should also note that this category does not include the mixed income of self-employed persons.

ESA 2010 describes the measurement of the volume of employee labour in paragraph 10.44, and defines the quantity of employee labour as “an hour’s work of a given type and level of skill”. This definition however does not specify what types and levels of skill have to be distinguished, and clearly there are a number of possible ways in which this can be reflected (educational level, type of job, level of compensation, grade), each of which may produce a different estimate of the volume component. This issue is further discussed below.

Paragraphs 11.35 to 11.37 of ESA 2010 provide a further explanation of the calculation of employee labour input in volume terms, namely that it should be labour input valued at the levels of compensation of employees existing during a base period.

Given the rather strict definition of volume of compensation of employees set in the ESA 2010, the price element of compensation of employees can be seen by implication

to include all changes in compensation of employees not related to skills-adjusted hours worked. This means that all changes in those elements of compensation of employees not directly related to hours worked (for example most income in kind, structure and level of social contributions) are included in the price effect. Thus it is possible to concentrate on two methods to estimate volume – using quantity of hours worked data directly (the extrapolation method) or deflating wages and salaries in cash (the deflation method) – with the price effect simply calculated at the end of the process as the implied ratio between current value and volume. There is no need to deflate the individual elements of compensation of employees, and concentrating on wages and salaries in cash is sufficient, if one assumes that all hours worked are reflected in wages and salaries in cash (that is, there are no hours worked which are wholly compensated for by income in kind).

Extrapolation method

The extrapolation method is based on a direct measurement of the quantity of labour – perhaps using hours worked or the ‘full-time equivalent’ number of employees, broken down by type of employee. If sufficient detail is available and the data can be considered complete, then the quantity extrapolation method is viable. The definition of “hours worked” is given in ESA 2010 paragraphs 11.27-11.29 – for extrapolating compensation of employees, of course, the hours worked should be purely for employees.

It may be necessary in practice to seek another measure of labour input for all or some areas of the labour market, to act as a proxy for hours worked. One alternative is to use “hours paid” as a quantity measure, though this does not represent the actual labour input to the production process (for example, paid holidays and sick leave are included). The total number of employees as an indicator of labour input cannot be considered suitable – any change in the proportion of part-time employment would not be captured.

The next step is to find a method of reflecting the skill levels of employees, so that the labour input data can be weighted appropriately and changes in the mix of skills over time can be reflected as a volume change. This can be seen as equivalent to determining the quality of labour input and allocating it to the volume component of compensation of employees. There are several possibilities here:

- *By educational level* – the use of a classification system based on ISCED (International Standard Classification of Education) will give a breakdown by the highest educational level achieved. The main concern with using this breakdown is that academic skills are given greater weight, and these may be less important amongst more experienced workers.

- *By occupation* – labour force surveys and structural earnings surveys typically use a detailed occupational classification (ISCO 2008, the International Standard Classification of Occupations), which can, for example, distinguish between different kinds of workers in the same industry.
- *By salary* – the rationale here is that workers with greater skills can command higher salaries. This assumes that there are no distortions or rigidities in the labour market that could cause relative salaries to imperfectly reflect relative skills.
- *By grade* – this is possible in those organisations or sectors where there is a common, established career structure. A good example is central government, where one can often find a common grading structure across ministries. Grade is often closely linked with salary, so one might expect similar results to using salary as a skill indicator.

The key point here is to define the “skill” that has to be measured. A possible definition is as follows “the skill of a labour input reflects the physical and mental ability that an employee brings to a particular job”. One should note two important points:

- The definition of skill is specifically related to the job undertaken. So a university graduate working as a waiter would not count as a higher level of skill than a waiter with no formal educational qualifications.
- The level of skill does not measure how hardworking a particular employee is. So a lazy employee with given ability would be measured in the same way as an equivalent hard-working employee. This means that ‘skill’ is not necessarily equivalent to ‘productivity’, though at the aggregate level we would expect a strong relation between the two concepts.

None of the four measures described above exactly measure the given definition of skill, so the task is to find the measure or combination of measures that could best approximate the definition. Various possibilities are discussed in the OECD productivity manual, including some quite complex multi-variable approaches.

There are both theoretical and practical difficulties with each of the possible skill measures. Use of grade is only possible for a very limited number of organisations and would not lead to a suitably harmonised approach. Use of salaries data, as a market proxy for skill, will tend to reflect prevailing supply and demand conditions; for example, the fact that there are a large number of skilled engineers looking for a job at a particular time, and therefore the relative wage of engineers falls, does not mean the skill of engineers has decreased relative to other occupations. Therefore salaries can be seen as only an approximate, longer-term, indicator for skill.

Of the two remaining measures, the use of an education measure might be seen to violate the 'job specific' requirement set out in point i) above, although it may also provide an indicator of general transferable skills which an employee can bring to the job. Given the difficulties with job-specificity and the need to specify a harmonised approach the recommendation of this manual is therefore to use occupation as the variable to adjust labour hours for skill, unless it can be shown that education and occupation are strongly correlated, in which case education could be used as an indicator. The level of detail used for occupation should be at least the 1-digit level of the ISCO classification. It is important to verify that the ISCO classification is being applied rigorously in the basic statistics (whether labour force surveys or structure of earnings surveys) so that there is no erosion over time in the basic standards applied.

Deflation method

An alternative approach, if hours worked data are not collected or are not available in sufficient detail, is to use wage indices to deflate the value of cash wages and salaries. This approach requires that the wage indices used meet certain criteria:

- a) They should be based on actual cash wages per hour. This means that if the data are available on only a per month or per year basis, they must be converted to a per hour basis, and;
- b) They should be broken down in sufficient detail to provide a deflator for groups of staff of homogenous skill.

In practice, meeting both these criteria perfectly will be extremely difficult. The first is less problematic because one can use contracted hours to make the conversion. But the second can present particular practical problems, depending on the structure of the labour market. There are two possible methods which can be used to approximate the required result.

The first is the Wage Rate (WR) method. Here, the work force is classified into a number of different categories of employee, and for each category the hourly wage rate of a "representative employee" is used, perhaps based on an official or industry-level rate. Weighting is preferably undertaken using the wages for the category in the current year to obtain a Paasche-type index, but a Laspeyres-type index may be a reasonable approximation to this if calculated at a sufficient level of detail.

In general, the stratification of the work force should be such that categories for which significantly different changes in wage rates occur are separately distinguished. In the extreme case that all employees always receive the same wage increase, no stratification at all is necessary.

The WR method defines the price/volume decomposition in the following way - if a price change is not specified in the wage rate change for a certain category, it will end up in the volume component.

The WR method is most suitable when there is a system of collective agreements in place that set common wage rates for large groups of employees. This is the case in various countries, and the method assumes that the collective wage increases give an indication of the actual changes in the price of labour, while all other wage increases are related to performance and hence are included in volume.

The second method available is the Average Wage (AW) method. This method uses average wages for categories of employee, but assumes that the total number of hours worked is not available. The starting point is an exhaustive set of data on numbers of employees and their salaries, in a detailed breakdown of grades and activities. The average wage increase per employee is determined for each of the detailed categories of employees, so that the wages of each category can be deflated separately. This approach implies that the decomposition into price and volume is implicit in the classification made in grades, activities, etc., and the detail of those classifications: shifts *between* the categories end up in the volume component, while wage increases *within* categories are included in the price component. Hence, the coverage of the volume component is increased when a more detailed stratification is used. The method is much more data-intensive than the WR method, and is most applicable to deflating the wages and salaries of government employees.

The AW method is comparable to a unit value approach, while the WR method is comparable to a price index compilation (see section 2.6). Each method requires certain conditions to be met if it is to be applied properly. For the WR method:

- the work force should be stratified such that those categories of employees with different wage rate increases are separately identified;
- the wage rate used for each category should be representative for that category;
- the wage rate should include the general wage rate change, specific wage rate changes for categories of employees, changes in allowances or bonuses that are not related to performance, and changes due to seniority;
- the weights should be total wages of each category of the current year or, alternatively, a recent year.

And for the AW method:

- the work force should be stratified such that those shifts between the categories of employees, which should be in the volume component, are separately identified;
- which implies that the work force should be stratified at least by grades, functions/activities, and seniority.

The level at which the calculation is conducted is an important determinant of the difference between the two methods. At the finest level of detail the WR method should converge with the AW method.

Nevertheless, both methods have weaknesses when compared with the extrapolation method, because neither method can lead in practice to a measure of volume that matches the ESA 2010 definition. The WR method suffers from an inability to distinguish between price changes caused by changes in skill and other price changes. The AW method suffers from the use of employee data rather than hours worked. Both of the methods can nevertheless reach an acceptable standard.

A, B and C methods

The quantity extrapolation method will be an A method if sufficient detail is available in the data to reflect the skill levels of employees (using occupation at a minimum breakdown of the 1-digit ISCO classification or education at the 1-digit ISCED level of occupation and education can be shown to be highly correlated), and if an “hours worked” measure is available for extrapolation. Use of “hours paid” to extrapolate, or the use of a less detailed occupational breakdown, will constitute B methods. Use of number of employees as a quantity indicator would constitute a C method.

Both the average wage and wage rate methods will be B methods if the conditions set out above are met; in particular that a sufficient level of stratification is used to distinguish reasonably homogenous groups of employees. As explained above, these methods cannot be A methods in practice because they will not lead to the required definition of volume.

Deflation of compensation of employees by an unrepresentative or general wage index is a C method. Deflation using a consumer price index is a C method since the result is a measure of the purchasing power of compensation, rather than the volume of input from employee labour.

3.11.3. Consumption of fixed capital

Consumption of fixed capital represents the amount of fixed assets used up during an accounting period. It should be calculated for all types of assets, both tangible and intangible, except animals. The main use of estimates of the consumption of fixed capital is to transform gross estimates (ie those that do not take account of the

consumption of fixed capital) into net measures. However, for non-market services, where output in current prices is derived as the sum of costs, the calculation of consumption of fixed capital directly influences the calculation of output.

The methods used for the estimation of the consumption of fixed capital at current prices are based on the stock of fixed assets and their probable economic life. The calculation of volume measures presents few problems when good data on the composition of the stock of fixed assets are available.

Most countries use the perpetual inventory method for the estimation of the consumption of fixed capital at current prices. This method requires the stock of fixed assets at previous year's prices to be calculated as an intermediate step in the current price calculation. The method employs detailed data on gross fixed capital formation and price indices. These detailed price indices allow the capital formation acquired over a number of years, and valued at their historic cost, to be revalued in terms of their replacement cost at a base year price. The price and volume indices derived in the process can be used to derive estimates of the consumption of fixed capital in volume terms. Further detail on the perpetual inventory method for the estimation of capital stock and the consumption of fixed capital can be found in the OECD manual on capital stock.

When there is no perpetual inventory of the stock of fixed capital, estimates of the consumption of fixed capital at previous year's prices can be derived by deflation of the current price estimates by suitable price indices. The price indices used can be those derived from data on gross fixed capital formation by product, see section 3.6. When using price indices from this source it is necessary to take account of the age structure of the capital goods within the stock of fixed assets.

The quality of the consumption of fixed capital estimates depends heavily on the quality of the price indices used for gross fixed capital formation, irrespective of the calculation method employed. The issues associated with the measurement of prices for gross fixed capital formation are discussed in section 3.6 and will not be repeated here.

A, B and C methods

The estimation of the consumption of fixed capital is closely linked to that for gross fixed capital formation. As such, the classification of methods that apply to gross fixed capital formation also apply to the consumption of fixed capital, see section 3.6. In summary, these are:

The use of genuine investment price indices (IPIs) will be an A method. The use of PPIs adjusted to purchasers' prices would also be an A method. To be an A method the coverage of these price indices should match exactly that of the products.

IPIs, or PPIs adjusted to purchasers' prices, where the coverage is not exactly that of the products or that do not take account of changes in quality would be a B method.

4. A/B/C methods for output by product

4.1 CPA A - Products of agriculture, forestry and fishing

Key aspects

Agricultural and fishing products are produced both for the market and for own final use, across incorporated and unincorporated enterprises. The methodology for measuring the output from economic activities of the agriculture and forestry industries is fully documented in the Manual on the Economic Accounts for Agriculture and Forestry (Rev 1.1 – 2000 Edition), which describes the volume valuation of activity in Section V. Three particularly important issues for National Accounts can be identified:

The production process may be spread over more than one accounting period. Whilst in Europe the production cycle is shorter than a year for the majority of crops, this becomes a major issue for forestry, fish farming, livestock rearing, and when quarterly accounts are prepared (see chapter 5 for further discussion). ESA 2010 is very specific on the method to be used for dealing with this: “*The output of agricultural products is recorded as being produced continuously over the entire period of production (and not only when the crops are harvested or animals slaughtered)*” (ESA 2010 3.54). The SNA 2008 (6.137 – 6.138) recommends that production should be recorded as work-in-progress, distributed according to costs incurred, and that accumulated work-in-progress should be transferred into inventories of finished products at the time of harvest (see section 3.7 for a discussion of volume issues for inventories and work-in-progress). In the EU this procedure is used for “cultivated forests” only, as defined by Member States in accordance with ESA principles; timber output from non-cultivated forests is measured at the time of cutting.

Agricultural prices tend to be very seasonal. There is often a distinct seasonal pattern in prices of fresh agricultural and fishing products, in both the wholesale and consumer markets. Discussion of methods to deal with this in the quarterly accounts can be found in chapter 5; the conclusion there is that the product detail used must be sufficient to distinguish seasonal varieties.

The complex nature of subsidies arising from the Common Agricultural Policy (CAP), Common Fisheries Policy (CFP), and domestic policies of the Member States, together with the range of tax benefits often available to farmers and fishermen, mean that adjustments for taxes, levies and subsidies need to be undertaken particularly carefully so that the basic price concept is followed. This is also true for the measurement of cross-border trade in agricultural goods, where tariffs and export subsidies are common, and where the general principle is that the prices are measured ‘f.o.b.’ for exports and ‘c.i.f.’ for imports (at the product level). Sections 3.9 and 3.10 cover the volume issues associated with these types of flows in more detail.

The agriculture and fishing industries have very detailed quality classifications for its products, with a well-developed (if complex) market pricing system, and a combination of slow innovation in products and generally overlapping sale of different products

means that measurement of quality change is not such a problem as it is in some manufacturing areas. That does not mean that major developments such as genetically modified and organic products should be ignored, but more data are generally available to undertake adjustments.

One important point to watch on quality is the extent to which products are processed on the farm or the boat – any change in the degree of processing should be dealt with as a volume change. Processed products (such as butter and cheese) are considered industrial products and should be classified accordingly. Statistical enquiries should cover this point adequately.

A practical point to watch when collecting data is the degree to which agricultural units undertake other non-agricultural activities, such as tourism or leisure services. This is a general point for national accounts, but is particularly relevant in agriculture. National accounts compilers should discuss with the agricultural colleagues the treatment of secondary activities within data sources, and in particular those that are considered “inseparable”, to ensure that the product-based data used is as close to the CPA definition as possible.

Under ESA 2010 (paragraph 1.95), non-marketed production (whether bartered or used for own-consumption) should be valued wherever possible at prevailing market prices (and therefore deflation to previous year’s prices should be undertaken on the same basis). This ensures a consistent treatment between market and non-market production.

Data availability

All Member States produce full annual agricultural economic accounts (at current and in volume terms), and undertake substantial data collection on agriculture and fishing, for both administrative and statistical purposes. Agricultural data collection typically takes the form of an annual census of production and a detailed structural survey every ten years. Member States define “representative products”, which are important products in domestic markets and which have clearly defined qualities. Fishing data are collected continuously, though no Member States as yet produces separate fishing accounts, and data for fish farming are sparse.

However it is necessary to ensure that the data used for national accounts purposes fully follow national accounts methodologies, and for this reason the relatively small differences between Economic Accounts for agriculture and National Accounts practices are set out in “Bridge Tables” (see Appendix XI of the Manual on Economic Accounts for Agriculture and Forestry http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-27-00-782/EN/KS-27-00-782-EN.PDF).

Information on subsidies is available from CAP and CFP-related data, or from governments’ records (in the case of national subsidies). However, one should be careful to distinguish between subsidies on products and other subsidies on production (including “set aside” payments) – the former must be taken into account in any price

indices used, the latter should not be (see sections 3.10 and 3.53.11.1 for further details). One must also take account of the periods for which subsidies are paid and ensure that subsidies are allocated to the time periods when the production was deemed to be undertaken.

A, B and C methods

Use of data from the Agricultural Economic Accounts, suitably adjusted for the small methodological differences with the National Accounts, and undertaken in line with the principles set out in chapter V of the Manual on the Economic Accounts for Agriculture and Forestry (particularly in relation to the elementary level of aggregation), is an A method.

There should be little reason to resort to B methods for agricultural and fisheries production since the necessary data is already collected by Member States, but it may be that some products are not fully separable into different varieties and seasons, or quality adjustments are not fully possible. Using approximate quality adjustments for these products would be considered B methods. This may be true, for example, for the output of farmed fish.

Any other methods which do not take quality into account or are based entirely on inputs are C methods.

4.2 CPA B - Mining and quarrying

Key aspects

The mining and quarrying heading covers the products of extraction of naturally occurring substances, such as coal, crude petroleum, and stone. It does not cover the processing of these substances, nor the subsequent sale of the processed products.

As with the agriculture and fishing industries, the mining and quarrying industry has very detailed quality classifications for its products, with a well-developed (spot and forward) market pricing system. There are two other aspects of this branch, which aid data collection – an industry generally concentrated in large (sometimes state-owned) firms, and little or no household production. One point to watch is the presence of subsidies or special tax regimes in some industries (for example in coal) which may be reflected in prices. It is also important to note that inventories are common in the industry and must be recorded appropriately (see section 3.7).

Data availability

For historical reasons, and because of the advantages to data collection set out above, there is an abundance of data available on the major mining and extraction industries – both for prices (PPIs are common) and volumes. Some products (for example extracted salt, fertilisers, and sand/gravel) may however be less comprehensively covered than major energy products such as coal and oil.

Information on subsidies and tax regimes should be readily available from government administrative sources.

A, B and C methods

Since volume data are collected in some detail for the major products (with subdivisions by quality) it is possible to measure volume output for extraction directly from this source. Value of output can also be deflated by actual price data, in the form of PPIs, so long as they meet the criteria set out in section 3.1.1. It is also possible to use unit values if the products included within each unit value calculation are perfectly homogeneous. These are the A methods.

There should be no reason to resort to B methods for mining and quarrying extraction, but there may be a lack of detailed data for some areas of the quarrying industry. Use of approximate quality adjustments, or using PPIs that do not meet all of the required criteria, would all be considered B methods.

4.3 CPA C - Manufactured products

4.3.1 General recommendations for manufactured products

Key aspects

This section deals with methods applicable to most of the diverse products classified to CPA C. Particular issues related to the measurement of volume output for large equipment goods and computers are covered in the following two sections.

CPA C covers manufactured goods including processed food products, clothing, refined fuels and chemicals, equipment of various kinds, and consumer durables. The features of manufactured goods – sold into a market, often produced in concentrated industries, tangible characteristics – together with the historical emphasis in statistical offices on measuring manufacturing (reflected for example in a detailed product classification), mean that theoretical and practical measurement are generally more straightforward than for some other CPA categories. However it is important to ensure that the general issues mentioned earlier in the handbook are satisfactorily covered, in particular:

- Quality – Changes in the quality of a product should be properly reflected as changes in volume. Section 2.4 discusses possible methods in more detail. For some products in CPA C, such as fashion goods (clothes, footwear) or high technology electrical goods, the definition of “quality” is not always straightforward. It may be, for example, that the hedonic methods described in section 4.3.3 on computers will need to be applied to other electrical products where the technology is changing rapidly (for example mobile phones).
- Price basis – The value of output should be deflated by a price index based on basic prices, and these should be based on actual prices not list prices (so that discounts are reflected in the price).

- Accruals basis – The data should relate to transactions in the period in question, not when the goods are paid for. This is particularly important for quarterly data collection (see chapter 5).

Data availability

There is generally no shortage of price or quantity data for manufactured products. For EU Member States, the Short Term Statistics Regulation (1165/98) requires the monthly production of indices of producer prices (PPIs), broken down by industry. These industry-level indices are themselves constructed from more detailed indices at product level. CPI data are available for manufactured goods sold to consumers, but these will have to be adjusted to basic prices before they can be used to deflate output.

A, B and C methods

The A method for manufactured goods is to use suitable PPIs to deflate the value of output, in particular PPIs that are representative of the product group, are valued at basic prices, and take proper account of quality. Clearly the PPIs should be sufficiently disaggregated to undertake deflation at the lowest possible product level. See also section 3.1.1 on the general procedures for deflating market output.

For certain manufactured products, where there are precise quality standards set for a homogenous product, an A method could also be to use data on the quantities of product at the necessary level of disaggregation, as long as these quantity data are fully representative. Examples of products that could be suitable for this treatment include bulk chemicals, wood pulp and petroleum.

One B method is to use detailed CPI data adjusted to basic prices for deflating the value of output. Use of less appropriate PPIs, for example where there is incomplete product coverage, would also be a B method.

Any methods based on input costs (except for unique products like large equipment goods), or which use an unrepresentative price index, are considered C methods.

4.3.2 Large equipment goods

Key aspects

The concept of volume measurement is founded in tracking the price of a basket of products between one period and the next. But this is not straightforward when a product changes significantly over time, or when it is a “one off” (see section 2.5). A large proportion of such unique products are found in the area of machinery and equipment; here referred to as “large equipment goods”. Examples are ships, oil rigs, aeroplanes and special purpose machinery.

Some of these products can, in themselves, have a significant impact on small, and even medium sized, economies. It is therefore important that they are not simply ignored by statisticians as an intractable problem; evidence from a number of countries confirms that the choice of method can have a significant effect on the volume measure.

The measures used should of course be completely consistent with National Accounts concepts:

- It is often the case that certain services are bundled with the sale of a capital good (for example aircraft manufacturers have a comprehensive “after-sales” service). These services should be included in any assessment of the quality of the product and therefore any changes must be seen as changes in volume.
- Many major capital projects span more than one accounting period. It is important that output and price measurements are taken for the period in question, and data adjusted if it relates to different (or many) accounting periods. It is particularly important to distinguish between tender prices and actual prices. Any work-in-progress must be identified, booked correctly, and deflated using the same method as output.

It is possible that the international market in large capital equipment is rather competitive, and therefore that international price movements (for example from a major producer of equipment of that type) can be taken as representative of the price movements in an individual country. The price movements should relate to the producer prices for the same or very similar equipment. One problem to overcome is how to deal with the effect of changes in exchange rates and inflation rates over time in different countries. There are three options:

(i) Using prices directly – this would use the direct price of the goods with no adjustment for inflation or exchange rates. The only suitable direct comparison would be if the contracts were specified in some common currency (such as euros).

(ii) Using a relative price index of the form:

$$\left(\frac{p_j}{p_g} \right)_A = \left(\frac{p_j}{p_g} \right)_B$$

where p_j is the price of equipment good j , p_g is the general price level excluding the equipment good, and A,B are different countries. This assumes that the price of the equipment good in country A relative to general inflation in country A evolves in the same way as the price of the equipment good in country B (a major producer) relative to the general inflation in country B. The effect is to control for different changes in general inflation between the two countries.

(iii) Adjusting for exchange rate movements – this assumes that changes in exchange rates fully feed through into changes in prices, which is a questionable assumption and includes exchange rate volatility within the price measure.

The choice of adjustment method can have a large impact on the measured price movement. If contract prices are specified in a major currency, option (i) is possible. If not, then for preference the relative price approach (option (ii)) could be used. A simple

adjustment for exchange rate movements (option iii) may be suitable in a limited number of circumstances where it can be shown that domestic prices of the specific good are extremely sensitive to the exchange rate.

Data availability

Only a handful of countries produce PPI's for goods such as ships and aircraft. Within Europe countries with small or no domestic industries producing major capital goods tend to use international pricing data for import flows, whilst others use a combination of input-based data, or output data from industries producing similar products. A couple of European countries, and the US, currently use methods which involve decomposing large products into a series of more generic elements ("specification pricing") or collecting data period-by-period on a specific combination of generic elements ("model pricing"). These techniques are described in more detail in section 2.5. Use of the techniques does involve a greater use of resources, both in the statistical office and in the responding organisations.

The European Regulation on Short Term Statistics (Council Regulation 1165/98) explicitly excluded the requirement to produce output price indices for defence, aerospace and shipping capital products. Nevertheless a number of Member States and others are examining their methodology with a view to moving towards output prices in due course.

A, B and C methods

The major product items considered here are ships, aircraft, trains, oil rigs and machinery for specialist industries (such as paper production). However the general principle for large equipment can be clearly stated – methods using unadjusted quantity indicators or based on unit value measures are considered as C methods.

Methods based on model pricing or specification pricing (see section 2.5) may be considered as A methods if the criteria set out in that section - namely regularly updated and representative models, and use of actual prices - are satisfied.

Two alternative methods can be employed:

- Use of *international prices* can be a B method if the prices can be considered representative of the Member State's domestic production (at the most detailed product level) and cross-border trade flows – the markets must be competitive, the data properly stratified and weighted, a suitable method used for adjusting for exchange rate movements, and foreign trade data should include second-hand equipment. It is recommended in any case that Member States remain in close contact over price changes for large goods, and draw on each other's experience as much as possible. In some cases, a country considered the major European producer could play the "lead role", in co-operation with Eurostat, to produce a suitable price index for use across all Member States.

- Use of specific and robust *quality adjustment* methods can be A or B methods depending on the suitability of the industry (for example, trains and special purpose machinery could be suitable industries for this method), though ideally they should be used in combination with the decomposition of major assets into their constituent elements. Various methods are examined in section 2.4.

For ships, the A method would be model pricing if the characteristics mentioned above and in section 2.5 are satisfied.

For oil rigs, the A method is the specification pricing approach to identify the modular elements of the rig, so long as adjustments for quality are applied to the elements. Pricing of the components with an adjustment for company margins and labour productivity would be considered a B method, as would use of an international index for certain types of ships – of large size and modular construction - which share the characteristics of oil rigs.

For aeroplanes, any method employed must be based on a careful stratification of the industry, must take into account the complex flows associated with co-operative projects (for example Airbus), and must adjust for exchange rate changes where prices are quoted in US dollars. The A methods here are model pricing and the specification pricing approaches, and both should benefit from the pre-dominance of commercial customers in the aeroplane market.

Model pricing and quality adjustment based on option prices (that is, estimating the marginal price of additional features) methods are both A methods for trains, provided that stratification at least extends to wagons/coaches/locomotives and to the different forms of propulsion technology.

For special purpose machinery (for example paper machinery), the A methods are model pricing and the specification pricing approaches, but appropriate quality adjustment methods can be used directly where the machinery is not suited for a decomposition method.

For defence goods, it is possible to apply similar methods to those described above (indeed it may be that military and civilian product prices move in a very similar way), but it is also common for defence ministries to compile their own price indices (often based on reports from contractors) so as to manage their financial affairs. National accountants should examine the methods employed carefully – if they are quality adjusted and based on actual evolution of output prices, they could be considered as produced by an A method.

Input methods will be acceptable, if none of these methods is applicable.

4.3.3 Computers

Computers are treated separately in this handbook because of two specific issues:

- The bundling of hardware and software, and

- The rapid technological changes that characterise these products.

The first issue is discussed in more detail in section 4.9 on computer and related services. The most evident example of bundling is the sale of a PC with operating system and perhaps other software.

The second issue becomes more and more important with the increased share of computers in investment expenditure. Although the impact on the volume of GDP can be limited if most computers are imported, the measurement of the volume increase of output of computers can have a significant impact on the measurement of components of GDP (such as GFCF and final consumption expenditure by households).

The problem is one of quality change, which was discussed at length in section 2.4. The various methods of handling quality changes were introduced there. The following methods can be appropriate to use for computers:

- the hedonic approach, since it is possible to determine and quantify the characteristics that influence the price;
- option prices, since in many cases separately priced options can be distinguished (such as additional memory or a DVD drive);
- the resampling method, as long as the sample is representative and large enough.

In view of the discounting practices for computers, in particular for PCs, the overlap method is less appropriate for these products.

The hedonic approach seems to be the best way to go in the end since it is very well possible to define and measure the characteristics that determine computer prices. The hedonic approach has proven itself in the USA as a useful and feasible tool for handling the problems of fast technological change. The hedonic approach is most appropriate if it is used for the estimation of prices of characteristics (and thus for quality adjustments only), and not for a direct price index. It is also possible to combine it with other methods such as option prices.

Comprehensive data on prices and technical characteristics of computers are required when applying hedonic adjustment techniques. Therefore, the hedonic approach is the most resource-intensive of the above techniques. The hedonic technique is a relatively complex method with a couple of different mathematical variants. It needs in particular considerable resources to set-up, but once set-up, the running of a hedonic method is not very resource-intensive. However, the model needs to be updated regularly. Besides the profound knowledge of statistical methods good knowledge of the technical aspects of computers is required, too. The technical characteristics covered (or not) have a direct effect on the results.

These costs can be reduced however by international co-operation. It can be expected that the hedonic function is not very different across countries due to the openness and competitiveness of the computer market worldwide. It would therefore be in principle

sufficient to estimate one hedonic model for e.g. the EU as a whole. The coefficients in this model could then be applied in national price index programs to adjust prices when replacements occur.

Due to the rapid turnover of models, for PCs price observation should be at least monthly. Preferably, price collection is carried out directly from the manufacturers or retailers. However, at least for the consumer market, price collection through magazines or the internet can also provide reliable enough data. If computers are sold together with software, this software needs to be recognized as a characteristic of the computer in the hedonic model.

Data availability

In most countries, price indices for computers are compiled within the frameworks of the producer price index (PPI) and the consumer price index (CPI).

Price data for PCs and related equipment such as printers, servers, etc. are generally readily available. Several countries rely on magazine prices, either for their PPIs or their CPIs. Data for larger systems are less widely available and their collection is more difficult. Catalogue prices are less likely to give an accurate reflection of market prices and the smaller quantities may make monitoring of actual transactions difficult.

A, B and C methods

An A method is deflation with a PPI that uses an appropriate quality adjustment procedure, which can be, as said above, the hedonic approach, option prices, or resampling.

For household consumption of PCs, list prices will provide an acceptable alternative for actual prices, but only for that case. List prices can for example be obtained from computer magazines or from the internet.

B methods are less appropriate PPIs, e.g. with a less appropriate quality adjustment procedure, such as the judgmental approach or production costs.

Another possible B method is the use of information from the US price index for computers, provided it can be shown that it is sufficiently representative for the domestic prices. The most appropriate option in this case is to use the US prices of computer characteristics, and to use these to make explicit quality adjustments to price data collected domestically. An appropriate mechanism for taking into account different general price changes or exchange rate changes should be applied. See section 4.3.2 for a discussion of the various possibilities.

Proxy methods, such as using price indexes from other electronic products should be classified as C methods. Also, methods based upon unit values are C methods. The use of a price index that does not take account of quality changes is also a C method. The unadjusted price comparison method and automatic linking are always C methods for computers.

4.3.4 Repair and installation services of machinery and equipment (CPA33).

The A method for repair and installation services is to use suitable PPIs to deflate the value of output, in particular PPIs that are representative of the service, are valued at basic prices, and take proper account of quality. The PPIs should be sufficiently disaggregated to undertake deflation at the lowest possible product level. An alternative A method is to collect data on hourly rates or quotes for 'model' jobs from contractors, and then to use these as indicators of price.

Use of less appropriate PPIs, for example where there is incomplete product coverage, would also be a B method. Any methods based on input costs, or which use an unrepresentative price index, are considered C methods.

4.4 CPA D - Electricity, gas, steam and air conditioning;

Key aspects

This section includes production and distribution of electricity, gas and air conditioning services to both business and household consumers. It does not include extraction of gas (which is included under CPA B)

There are two distinct characteristics that make measuring volume output for this particular product category easier than for many other categories:

- The major products are relatively homogenous – a KW hour of electricity, a cubic metre of gas – and values are calculated as price times volume. So quantity measures can be used directly in measuring volume output.
- The industries are generally concentrated, with one or very few large firms, often state-owned, so data gathering is relatively straightforward. The issue of distribution networks is discussed in more detail below.

There are a couple of issues which do require careful treatment:

- Price discrimination within the market – most utility companies charge different prices for different users (for example between bulk business users, other business users, and private customers). This can create a similar problem of complex tariffs as that encountered in the telecommunications industry (see section 4.8), particularly as markets are liberalised and the tariff structures become more complicated. It is important, if using price indices, that a clear distinction is drawn between price differences based on quality (for example electricity supplied at night compared with supply during the day, or gas supplied in the summer compared with gas supplied in the winter, or there may be a different tariff for "green" electricity) and price discrimination. The former case can be treated as different products (see the discussion of seasonal products in section 5.3.2). ESA 2010 par. 10.16 says that price discrimination only applies when different prices are charged for identical products sold under exactly the same circumstances. An example would be sales of electricity to a

small business and to a private house at a particular hour of the day – whilst the product is exactly the same, and the small business may not benefit from any bulk discounts, it is often the case that the business is charged at a different rate (business tariff) from the household. It is of course important that any discounts given to bulk users are included within price movements.

- A common structure in these industries is for a division between producers and distributors. Sometimes this occurs in a single, vertically integrated, enterprise (though this may well have distinct kind-of-activity units), but often more than one enterprise is present, and the raw products sold by producers to distributors. There are two possible methodologies for recording distribution: 'net' – that is, the output of distributors is the margin for distribution, and 'gross' – where the output of the company is measured in terms of the product delivered. For net recording, this means that there are similar issues to section 4.7.1 in the measurement of margins at previous year's prices.

Data availability

As discussed above, data are widely available on volumes of product, and producer price indices are compiled. Data on distribution are less readily available. Consumer price indices are also widely available, but these are only applicable to output sold to households.

A, B and C methods

We can distinguish between production and distribution for the discussion of appropriate methods:

Production

The A method here is to deflate value of output by the available PPIs, assuming that they satisfy the standard conditions set out in section 3.1.1, and take full account of any 'standing charges' (payments unrelated to consumption) levied by the companies. A fully equivalent approach, which would also be an A method, is to directly use the quantity data available on products, providing the quantity data is sufficiently detailed (i.e. it identifies the quantities delivered by tariff and customer type).

Distribution

There are two sets of methods for distribution, depending on whether a gross or net (margin) basis of recording is used.

Net recording

The A method for measuring distribution margins is a method taking the changes in quality of the distribution services into account. Section 4.7.1 contains a fuller explanation of the issues and techniques for measuring margins at previous year's prices. So far, the only method that can properly account for quality changes – in theory

– is deflating sales and purchases separately. A suitable B method is to assume that the volume of the service follows the quantity of the product distributed, e.g. the volume of electricity distribution output follows the quantity of electricity output.

Any other method, in particular the deflation of margin output directly by a producer price index, is a C method.

Gross recording

In the case of gross recording, the A method for deflating output is to use a suitable PPI to deflate value of output at basic prices, where the PPI has been compiled for the combination of production and distribution components of output. Suitable B methods include using CPI data to deflate total output if this can be shown to be representative for output consumed by businesses, and using the quantity of output to provide an indicator of the combined production and distribution products.

Any other method, especially those based on input costs, is a C method.

4.5 CPA E - Water supply; sewerage, waste management and remediation services

This includes:

- CPA 36 - Natural water, water treatment and supply services
- CPA 37 - Sewerage services; sewage sludge;
- CPA 38 - Waste collection, treatment and disposal services; materials recovery services
- CPA 39 - Remediation services and other waste management services

Key aspects

These product divisions consist mostly of market services, though waste collection and disposal services can be provided as non-market or market services. The particular difficulty here is not so much with defining output (for example tonnes of rubbish collected or quantity of sewage treated) as with separating the individual price of the service from those of other products. For example, waste collection and disposal services may be paid for as part of a general charge or local taxation for businesses and households, and sewage service charges may be included in a general charge for water supply and disposal.

Data availability

Given that sewage services tend to be provided by major utilities (whether publicly or privately owned), and waste collection disposal services by units of local government, price and volume data might be readily available, though enquiries will need to separate the services from others provided in the same charge. The CPI could capture data on services provided to households.

A, B and C methods

A methods include the use of suitable PPIs where they are available, and output volume indicators (such as tonnes of refuse collected) adjusted for certain quality features of the service, such as regularity of collection and treatment of speciality refuse (e.g. toxic waste).

B methods include the use of detailed CPI indices for both household and business consumption (where the evolution of prices for services to businesses is shown to be similar to services to households). For non-market services, use of output volume indicators would be considered a B method if those indicators provide good coverage and are sufficiently detailed.

4.6 CPA F – Constructions and construction works

Key aspects

Construction output covers a wide range of products including one-dwelling and multi-dwelling buildings, industrial and commercial buildings, highways, railways, and other major civil engineering projects. The output covers new construction, major improvement of existing structures and regular repair and maintenance. In addition to this broad coverage, other features of the construction sector require close attention in measuring output at both current prices and in volume terms:

- Some new building or improvement projects may span two or more accounting periods, and there may be a significant delay between the signature of a contract and the work commencing. Thus output must be allocated to accounting periods, and in prices determined for each period.
- Every building project can be considered unique – even seemingly identical buildings may be different because of site conditions – which complicates the measurement of quality. Projects should therefore be decomposed wherever possible into standard activities that can be priced between periods. Small and medium sized firms, together with the self-employed, produce a significant proportion (and sometimes majority) of construction output in Member States. They are often linked to larger firms and with each other by complex sub-contracting arrangements, which complicates data collection. The nature of the industry means that adjustments are likely to be needed for the hidden economy. Construction output includes own-account construction undertaken by households, which requires a different data collection mechanism.
- The broad mix of output between residential and non-residential building and civil engineering projects can and does change between accounting periods, so it is important that sufficient detail is used in the weighting. In addition, construction output tends to be very cyclical over time, following (and even leading) the overall economic cycle closely.

It is clear however that whichever method selected will have to satisfy the basic criteria set out in section 3.1.1 – be consistent with National Accounts concepts; using the appropriate ‘basic’ price basis; provide full coverage of the activities under the classification heading (both functionally and geographically); treat quality changes as volume changes; use actual rather than artificial prices; and ensure that all measures are appropriate to the time period.

Data availability

The OECD-Eurostat publication *Construction Price Indices* provides a review of the types of price indices available in EU Member States. Most Member States have input price indices, whilst some also have output price indices (using various methods, including hedonic methods for new houses). Whether input or output, the price indices do not generally cover all types of construction. Moreover countries having both input and output price indices do not necessarily have them for the same types of construction.

The Regulation on Short Term Statistics (Council Regulation 1165/98) does not require output price data for construction, but only input price data. The joint Eurostat – OECD publication *Sources and Methods Construction Price Indices* sets out the conceptual problems and Member States approaches to compile price indices for construction.

The Purchasing Power Parities (PPPs) programme for construction has resulted in an annual collection of detailed data which can be used to price a ‘standard’ output. This should be considered a helpful comparative source for work on construction data, but is not suitable for direct use in deflating construction output in the national accounts; adjustments would need to be made for actual prices, to improve comparability across time, and a wider range of standard outputs collected (so that the outputs are more relevant for individual Member States).

The choice of methods will have resource implications for the National Statistical Institute – some methods are certainly more resource intensive than others. It is worth pointing out that construction statistics often receive a far lower proportion of statistical resources than the sector’s importance in the economy would warrant.

A, B and C methods

Whilst all Member States collect input price indices, very few collect output price indices. The experience of a number of countries has shown that the use of input price indices to deflate output leads to significantly different results from use of genuine output indices (especially at the turning points of the economic cycle) – use of input indices to deflate output is therefore discouraged and is viewed as a C method. There is a range of possible methods for estimating output price indices:

- The “actual prices” method takes data from real projects undertaken during the period, or adjusts tender price indices to match the relevant time period, and can be considered an A method provided that the constructions priced in different periods are directly comparable, or if the prices are suitably quality-adjusted when changes in the constructions being compared exist. This method

is resource intensive, but can be used for all types of construction, if suitably weighted, if some generic designs are used repeatedly, and if a sufficiently large sample of projects is taken. However it will not be suitable if the projects are genuinely unique.

- The “model pricing” method, which constructs a theoretical “model project” (such as a one-family dwelling) using tender price data from standard price books or statistical surveys. It can be considered an A method if the model projects are sufficiently representative of the population of construction projects, and if a method can be found to encourage surveyed firms to provide reasonably representative estimates (perhaps by asking for the firms to report their discount rates).
- The “hedonic” method, which attempts to define the quality of a structure in terms of its characteristics and regress them against price (see section 2.4.2) can be considered a B method. However the regression must employ good quality data, including the use of actual prices. It is important that the hedonic method is employed only in suitable areas of construction (it is unlikely that the method will be generally applicable).

Volume methods (such as measuring cubic metres of construction, or the number of building permits issued) are to be considered C methods.

The above methods are generally applicable to non-civil construction. It is important to consider methods for both civil engineering projects, and for repair/maintenance of existing structures.

- *Civil Engineering* – These projects are generally large and unique. Many of the principles set out in section 2.5 of this manual on the pricing of major projects are equally applicable here, particularly the decomposition of the project into a set of more measurable components. Some Member States collect detailed prices as part of the administrative control of public building contracts, and this can be considered a B method if the data are representative.
- *Repair/Maintenance* – For paid repair and maintenance work, it is possible to collect data on hourly rates or quotes for ‘model’ jobs from contractors, and then to use these as indicators of price. For small repair and maintenance work undertaken by private households CPI indices for materials commonly used in these activities can be employed.
- Finally, construction output on “own account” (where a structural improvement takes place) by households should be deflated by an appropriate index. Whilst much of this activity is probably undertaken using the services of specialist sole traders (often informally), the B method here is to deflate activity by the closest market-based index available, for example relating to residential dwellings or even a subset of that.

4.7 CPA G - Wholesale and retail trade services; repair services of motor vehicles and motorcycles

4.7.1 Wholesale and retail trade margins

Introduction

The main part of the output of CPA G consists of wholesale and retail trade margins. A trade margin is – broadly speaking – the difference between the sales price and the purchase price of a good that is being traded (see ESA 2010 par. 3.56 for a more precise definition). The trade margin can be seen as the price the buyer pays for the trade service although there is no direct transaction.

Wholesale and retail trade is thus treated rather differently than other activities in the national accounts. Traders play an essential role in the distribution of goods in the economy. In the national accounts, traders do not process the products they trade, except for some cleaning or packaging. They supply services rather than goods (although consumers may have a different perception of this). Although keeping an inventory of goods for resale may be seen as an essential part of their activity and part of the service provided to consumers, this is not seen in the national accounts as part of the output. For traders, a distinction has to be made between products purchased for resale and products purchased for intermediate consumption.

One advantage of the net treatment of trade services adopted by the national accounts is that the consumption of households by product can be shown explicitly. If a gross treatment were adopted, households would only be buying trade products, and it would be difficult to analyse the product composition of consumption.

In measuring the volume of the output of trade services, in principle an analysis should be made of the actual services provided by the trader to the customer. Generally speaking, the service provided is to make available various goods at a location and time convenient for the customer. There are many aspects consumers (implicitly or explicitly) consider in deciding in which shop their purchases will be made. These include:

- the price level
- the quality of the products
- the quality of the trade service provided, e.g.
 - the range of products on sale (can one buy everything one needs in one shop or does one have to go to several shops)
 - the accessibility of the shop (availability of parking space, distance from home, opening hours, etc.)
 - general service level of the staff (friendliness, knowledge of the products, guarantees, waiting times at check-out, etc.).

Different forms of trade provide different services, and these services change continuously over time. Good volume measurement would imply keeping track of the amount of each different service provided over time, including their changes in quality. It is however very difficult to exactly define the types of services provided, let alone to measure their quantities. The current state of statistical information on wholesale and retail trade does at least not allow such measurement.

Therefore, statistical offices have so far used data on the volume of sales as indicators for the volume of trade services. In general, one can expect that there is a reasonable correlation between the volume of sales and the volume of trade services, but it does leave aside all changes in the (quality of) trade services provided, and therefore does not give a complete picture of the activity of this branch.

One approach that could in theory take changes in the quality of trade services into account is to apply the way output in current prices is calculated (as the margin) also to the volume calculations, i.e. to calculate the margin in previous year's prices as the difference between the sales and the purchases in previous year's prices. This is elaborated in the next section.

Taking quality changes of trade services into account

Consider the following example of a retailer (disregard changes in inventories).

	Purchases of goods for resale	Retail trade margin	Sales of goods for resale
Value T	214	47 (18%)	261
<i>Price index</i>	<i>101.9</i>	<i>105.4</i>	<i>102.5</i>
Volume T (prices T-1)	210	44.6 (17.5%)	254.6
<i>Volume index</i>	<i>105.0</i>	<i>111.5</i>	<i>106.1</i>
Value T-1	200	40 (16.7%)	240

The margin-to-sales ratio in current prices increased from 16.7% to 18%. The question is how much of that is a volume change and how much a price change. Suppose we have a price index for the sales (i.e. a retail price index, in the example 102.5) and a separate index for the purchases (i.e. a wholesale price index, in the example 101.9). The sales price index will relate to the composite product "good+trade service". That means that this price index should take account of changes in the quality of the good as well as of the trade service. The price index for the purchases only captures the price change of the good (and perhaps other services included up to this point, but ignored here).

We can now derive the margin in previous year's prices by deflating sales and purchases with the corresponding price indices. The value of the margin in prices of the previous year is equal to the difference between the values of sales and purchases in prices of

the previous year. The derived price index for the margin in the example is 105.4, dividing the change in the margin-to-sales ratio into a price and a volume component.

Note that, if wholesale and retail trade were to be recorded on a gross basis and double deflation were used to estimate value added at previous year's prices, the result would be exactly the same. Output would be deflated by a sales price index (a CPI for example) and intermediate consumption (which would include the purchase of goods for resale) by an index reflecting the prices of the purchases (a PPI for example).

The same problem that was described in section 3.4 on value added occurs here too (and is perhaps even more important): when sales and purchases are very close in value (and thus the margin is very small), and the reliability of the price indices is not very high, the estimate of the volume of the margin can become erratic.

Regarding the volume indices, if there are no changes in inventories, the change in the quantity of goods purchased will be equal to the change in the quantity of goods sold. The volume change of purchases, however, need not be equal to the volume change of sales since the quality of the trade service might have changed. This is the case in the example: sales grow at 6.1% while purchases grow at 5%.

If the two price indices were the same, the margin-to-sales ratio in prices of the previous year would be 18% (as in the current year), so that the whole of the change in margin would be attributed to the volume component. In the opposite case, the two volume indices would be equal implying no quality change (the margin-to-sales ratio in prices of the previous year would be 16.7%).

Such a procedure requires high quality price indices. In particular, the sales price index should take account of changes in quality of the trade service, and the sales price index and the purchase price index should measure the price of the good in a consistent way. Clearly, these requirements will in practice not easily be met.

Take the CPI for example. Most countries will include various outlets for various products in their samples of consumer prices. That means in fact that the same product bought in two different outlets is treated as two different products. Consider an example of loaves of bread sold by bakeries and supermarkets. Assume for the sake of the example that the bread is exactly the same in both outlets.

	Bakery		Supermarket		Total	
	T-1	T	T-1	T	T-1	T
Number of loaves sold	100	120	200	180	300	300
Price per loaf	3	3	2	2	2.33	2.40
Turnover	300	360	400	360	700	720

The only aspect that changed between T-1 and T is that more consumers bought bread at the bakery instead of at the supermarket, even if the price of a loaf in the supermarket is lower. This increased the total turnover and the average price per loaf. If the CPI did indeed observe the prices in these two outlets, then it would show no change. Deflation of the total turnover by such a CPI would imply that the whole of the average price increase is seen as a volume increase, namely an increase in the quality of the average trade service level.

In the more realistic case where consumers shift from the bakery to the supermarket, the following happens:

	Bakery		Supermarket		Total	
	T-1	T	T-1	T	T-1	T
Number of loaves sold	100	80	200	220	300	300
Price per loaf	3	3	2	2	2.33	2.27
Turnover	300	240	400	440	700	680

In this case, the average price per loaf falls since more of the cheaper variety is bought. Apparently, the price difference between the two shops is valued higher than the quality difference, in other words: the consumers do not care as much about the loss of service from the trader as they do about the lower price. The CPI would again show no change, so that the average price decrease becomes a volume effect, i.e. the accounts will show a decrease in the average quality of the trade services.

Notice that in the examples the prices are kept constant. This is purely for reasons of clarity. It would be perfectly possible to adjust the examples so that prices would change. In that case shifts between outlets will also be included in the volume component if the CPI treats products from the two outlets as two different products.

The implicit assumption that is made in both cases is that a higher margin corresponds to a higher quality service, *and* that the difference in quality is exactly equal to the difference in the margin. It assumes that consumers make a choice that is based on full knowledge about prices, margins, quality of services, etc. of all available outlets. These implicit assumptions are very questionable. Some service aspects of the supermarket might be very highly valued, such as the broader range of products and the availability of parking space, as mentioned above.

The Boskin commission criticised the US CPI for the existence of the so-called “outlet substitution bias”. This criticism is aimed at the use of these implicit assumptions. The Boskin commission argued that price differences between outlets are – to a certain extent – real price differences. Thus, the price difference between the bakery and the

supermarket in the example above cannot entirely be explained by the quality difference in the trade service provided. This would imply that the consumers experienced a price decline, not shown by the CPI.

The situation is even more complicated if new trade channels appear such as e-commerce. Internet supermarkets, book stores and the like are able to survive on lower margins because they have much lower costs. The appearance of such new outlets effectively reduce the overall price level for the consumer.

In addition, consumers are increasingly purchasing goods over the internet, some of which will be sourced from abroad. In this case, the retail price will include the cost of distribution and may also be affected by any exchange rate movements. Deflation of such trade should therefore be exchange rate adjusted.

In conclusion, a good-quality CPI would take quality changes in trade services into account as far as they concern substitution between different outlets. It is unlikely that in the compilation of CPIs often quality adjustments are made for changes in the services provided by a particular outlet. And given the above remarks on the outlet substitution bias, we can only conclude that even a good-quality CPI can take only limited account of quality changes in trade services. That means that the above-outlined procedure of deflating sales and purchases separately takes quality into account only to the same extent as the CPI (or another index used for deflating sales).

Using the volume of sales

The most widely used method of estimating the volume of margin output is to assume that the volume of margins follows the volume of sales. This assumes that margin-to-sales ratios are constant in previous year's prices. As can be seen from the first example in the previous section (take the case where the margin-to-sales ratio in prices of the previous year would be 16.7%), this implies that it is assumed that there are no quality changes in the trade service.

A volume index of sales can be obtained by deflating sales by a sales price index. For retail trade, this should be an index of retail sales prices, e.g. a CPI. For wholesale trade, the appropriate index would be a wholesale price index, provided this measures the sales prices of wholesalers (and not the price of their purchases). Where a wholesale price index is not available, a CPI or PPI can be used as proxy. Which one is the more appropriate depends on the product in question and on the importance of wholesale compared with retail in the distribution chain of the product.

In the example (that relates to a retailer), the sales price index (e.g. the CPI) is 102.5, yielding a volume index of 106.1. The latter would be used to extrapolate the margin value of the previous year. The result would be as follows:

	Purchases of goods for resale	Retail trade margin	Sales of goods for resale
Value T	214	47 (18%)	261
<i>Price index</i>	<i>100.9</i>	<i>105.4</i>	<i>102.5</i>
Volume T (prices T-1)	212.2	42.4 (16.7%)	254.6
<i>Volume index</i>	<i>106.1</i>	<i>106.1</i>	<i>106.1</i>
Value T-1	200	40 (16.7%)	240

Obviously, the same remarks are valid as concerns the extent to which a CPI takes quality changes of trade services into account. Hence, the sales price index might to a certain extent account for these quality changes, so that the volume index is slightly more than a quantity index.

This method can be applied at the level of the overall economy, i.e. to deflate total margin output. However, it would be much better to add product detail, preferably by calculating trade margins in previous year's prices within the detailed framework of supply and use tables. Then, the margin-to-sales ratio on a specific cell of the use table calculated in the previous year can be applied to the volume of that cell in the current year. In this process, account should be taken of changes in the share of wholesale and retail trade in the total distribution chain of a particular product, since not all products need necessarily be purchased through a wholesaler or retailer. For household consumption, for example, in principle only the products purchased through wholesale and/or retail trade should be deflated to derive the volume of the turnover and therewith the margin.

If the price indices used to deflate sales do not make use of a breakdown of outlets, so that no quality changes at all are taken into account, then one could breakdown the trade margins into a number of different trade channels or outlets, and apply the above procedure of constant margin ratios in previous year's prices at the level of these different trade channels. This would again include shifts between trade channels in the volume component.

It would be worthwhile to investigate whether it is possible to make explicit quality adjustments to the sales volume indices, for example based on quality indicators of the trade industry such as indicators of the variety of products on sale, waiting times at check-out, availability of parking space, etc. Currently, this kind of quality indicators does not seem readily available.

A, B and C methods

The A method for margin output is a method taking the changes in quality of the trade services into account. So far, the only method that can do so – in theory – is by taking the difference between deflated sales and deflated purchases. It should be stressed

though that it is necessary to continue research into more accurate descriptions of the trade industry, in order to improve the volume measurement and in general our understanding of the trends in wholesale and retail trade.

A number of countries are experimenting with "margin price indices". These are price indices that view the margin as the price of the trade service provided, and follow these margins over time keeping the quality of the trade services constant. This method has the potential of becoming an A method, provided it can indeed take appropriate account of quality changes.

As a B method can be used the assumption that the volume of margins follows the volume of sales, or – equivalently – that margin-to-sales ratios are constant in previous year's prices. This should preferably be applied in the framework of detailed supply and use tables in previous year's prices, and – if possible – in such a way that shifts between outlets are included in the volume component of output.

Any other methods, in particular the deflation of margin output directly by a sales price index, are C methods.

4.7.2 CPA 45 - Wholesale and retail trade and repair services of motor vehicles and motorcycles

Apart from wholesale and retail trade services, yielding margin output, this division of CPA contains the service output for maintenance and repair of motor vehicles and motorcycles. For this type of output, PPIs could be available, in which case they constitute the A method. If they are not available, the products can be deflated using CPIs (corrected for any taxes or subsidies), which are a B method, because it might not sufficiently cover business expenditure.

Furthermore, there are trade services that are paid for on a fee or contract basis. This refers to situations where someone sells a product on behalf of someone else, thus without purchasing the product him- or herself. For these services, the fees paid should be the basis for deflation, in combination with the prices of the products sold. See e.g. section 4.12.1 on real estate services for a similar case of services paid on a fee or contract basis.

4.7.3 CPA 46 - Wholesale trade services, except of motor vehicles and motorcycles

This division is divided into 46.1 Sales on a fee or contract basis and 46.2 to 46.7 Wholesale trade services (of various products). Wholesale trade services give rise to trade margins and are covered in section 4.7.1. In section 4.7.2 some remarks are made on sales on a fee or contract basis.

4.7.4 CPA 47 - Retail trade services, except of motor vehicles and motorcycles

This division of CPA reflects the margin output of retail trade services discussed in section 4.7.1

4.8 CPA H – Transportation and storage services

In considering methods suitable for the estimation of prices and volumes for CPA H it is useful to distinguish three separate groupings of services: transport services; supporting and auxiliary transport services; and postal and courier services. For transport services, the additional distinction between passenger transport and freight transport has to be made.

4.8.1 CPA 49, 50 and 51 - Transport by land, water and air

Passenger transport

Key aspects

Transport services whilst very diverse in terms of the mode of transportation, have much in common with one another. The service being provided is to move people from one place to another. Within the different forms of travel (air, sea, rail and road) quality is an important issue. Factors such as speed, convenience, comfort, reliability, timeliness need to be considered because shifts can occur that need to be reflected correctly in price or volume. This calls for measurement to be carried out at a detailed level.

Some forms of passenger transport, principally those by bus and train, can be purchased in different ways. Examples of these are the purchase of a ticket for a 'one-off' journey or a season ticket that gives the right to travel any number of times within a defined time period. Each different type of ticket could be seen as a separate product, giving different rights under varying conditions. The output in current prices is essentially equal to the number of tickets sold times the price per ticket, for all different types of tickets. It follows that output in previous year's prices should be equal to the number of tickets sold times the price of each ticket in the previous year. This approach is also followed in the compilation of price indices, where the prices of the different forms of tickets are usually observed and weighted with total sales or purchases of each type of ticket in the base year.

The consequences of this approach should be carefully considered. It implies for example, that a kilometre travelled by train on a 'one-off' ticket is a different output than a kilometre travelled on a season ticket. It also implies that a train travelling without passengers still produces output, since season ticket holders have already paid. In this case, output may be seen as not being directly related to the use of the transport service, but as the right of access to it.

In many instances, volume data on the amount of passenger-kilometres produced are available and are used in the national accounts as volume indicators. The use of such an indicator typically assumes that only the actual transport of passengers yields output (i.e. an empty train does not produce output).

To compare the variation in passenger-kilometres and tickets sold (per type of ticket), the following formula can be used:

$$\begin{aligned} & \textit{number of tickets sold} * \textit{average number of travels per ticket} * \textit{average distance per} \\ & \textit{travel} \\ & = \\ & \textit{number of passenger-kilometres for this type of ticket.} \end{aligned}$$

From this formula it can easily be seen that if, for one type of ticket, the travel habits of the population do not change over time, changes in the two indicators (tickets sold and passenger-kilometres) will show the same trend.

For single (one-way) tickets, passenger-kilometres will give similar results as counting the number of such tickets sold (since the average number of travels per tickets is by definition equal to one). However, there are examples where such a ticket permits travel within a pre-defined area rather than simply from one location to another, for example city travel tickets. Then, the relation between the number of tickets and passenger-kilometres depends on the changes in the average distance travelled per ticket.

For season tickets, the relation between passenger-kilometres and tickets sold depends both on the average number of travels per ticket and the average distance travelled each time. It is possible to imagine the case where the season ticket holder makes no actual journeys, in which case the number of passenger-kilometres is zero, but still output is produced.

The opposite case is that of free travel: in some cases, students or elderly people can travel for free on bus or train. Then, this travel will be included in the number of passenger-kilometres but not in an index based on tickets sold. One could wonder however if this travel is indeed truly free-of-charge. Usually, the government will pay the transport company for the travel of those people.

Tickets restricted to peak or off-peak travel and first class or second class travel also represent different qualities of product. Quality has already been identified as an important issue for transport services. Prices of different tickets are readily available, and conditions of sale can be monitored relatively easily. This should allow the correct estimation of price and volume provided the output at current prices can be identified separately for each type of ticket.

Discounts are also commonly offered for passenger transport services. Road, rail and sea transport may be offered at reduced prices on presentation of a discount card. Air tickets are often available for the same journey at different prices depending on factors such as the degree of flexibility offered to the traveller or the time before the date of travel that the ticket is purchased. Regular flyer programmes also offer discounted airfares, free flights or upgrades, all of which represent different quality products that need to be reflected correctly in prices and volumes.

A significant complication in the deflation of output of passenger transport is the frequent occurrence of subsidies. Whereas transport companies have become market

producers in most countries, they are often largely subsidised in order to keep prices affordable or to keep certain unprofitable routes open. The nature of the subsidies can vary considerably between countries. In some cases they are given per passenger-kilometres produced, in other cases they are a lump-sum amount. ESA 2010, par. 4.35(c), states that such subsidies are to be seen as subsidies on products (D319), and are therefore part of the basic price. Deflation of subsidies on products is discussed in section 3.10.

Data availability

For transport services provided to households, CPIs are generally available. PPIs for transport are increasingly collected, although volume indicators such as passenger-kilometres are more widely available. However, the level of detail for such volume indicators is often limited.

A, B and C methods

The very different nature of the products covered within this CPA category makes it sensible to define a minimum level of detail to be used in estimating prices and volumes. For passenger transport, the product level used should, subject to each product making a significant contribution to output, at least identify separately:

- transport via railways,
- other land transport,
- water transport and
- air transport.

If these breakdowns are not attained, any method will be a C method.

Detailed current price data is required as weights for price or volume indices. If product level detail at current prices is not available at the level described above, other indicators could be used as weights. These other indicators will still need to distinguish the different types of transport and approximate the current prices as closely as possible.

The use of appropriate PPIs is an A method. For PPIs to be considered appropriate they would need to cover the various types of tickets available.

The use of a CPI adjusted to basic prices for passenger transport is a B method providing it takes sufficient account of quality changes.

Volume indicator methods based on passenger-kilometres for passenger transport are B methods, since it has to be assumed that travel habits of the population do not change significantly. The more detail available for these volume indicators, the better will be the result. For passenger transport the volume indicators should at least distinguish between the different classes of travel, for example first and second class for rail transport and economy and business class for air transport.

All other methods are C methods, including the use of volume indicator methods based only on the number of passengers transported.

Freight transport

Key aspects

For freight transport, it is more difficult to compile price indices than it is for passenger transport. That is because there are in general no fixed tariffs. The price for transporting goods from A to B can depend on a variety of factors, such as the distance between A and B, the weight of the freight, whether it concerns a domestic or an international journey, whether there is return freight from B to A, the kind of product transported (livestock, bulk products, chemicals, etc., they require different facilities and are therefore differently priced), etc. Thus, one can say that freight transport has - at least to a certain extent - the characteristics of unique products.

One way of compiling price indices is therefore to resort to a form of model pricing (see also section 2.5). A set of representative standard journeys could be formulated which would be priced by the producers of the transport services. A hedonic approach in which the price of each journey is regressed on its characteristics is also imaginable. In each case, the characteristics "weight of load" and "distance" would be included in the analysis. But both approaches offer the opportunity to monitor for other (quality) aspects of the journeys.

The volume of output can also be approximated directly by the use of volume indicators such as tonne-kilometres. This indicator, however, only accounts for load and distance and therefore cannot take changes in other aspects into account.

Transport services can also be an important component of exports or imports of services and methods described here are also appropriate for external trade in services.

Furthermore, a large part of the output of transport services (i.e. the part related to the transport of newly produced goods) forms part of the difference between the basic price and the purchaser's price of a good. These are the transport margins (see ESA 2010, par. 9.37 for a definition). For the deflation of the transport margins, the same rules apply as for transport services in general.

Data availability

PPIs for freight transport are not widely available, probably due to the problems of measurement mentioned above. However, volume data on tonne-kilometres are widely available, generally broken down by mode of transport.

A, B and C methods

For freight transport, the product level used should, subject to each product making a significant contribution to output, at least identify separately:

- transport via railways,

- other land transport,
- transport via pipelines,
- sea and coastal water transport,
- inland water transport and
- air transport.

If these breakdowns are not attained, any method will be a C method.

Detailed current price data are required as weights for price or volume indices. If product level detail at current prices is not available at the level described above, other indicators could be used as weights. These other indicators will still need to distinguish the different types of transport and approximate the current prices as closely as possible.

The use of appropriate PPIs, possibly based on the model pricing approach, would constitute an A method for freight transport. Volume indicator methods based on tonne-kilometres transported are B methods.

All other methods are C methods, including the use of volume indicator methods based only on the number of tonnes transported.

4.8.2 CPA 52 - Warehousing and support services for transportation

Key aspects

Many of the services of this branch are provided only to businesses. The services are generally provided on payment of a fee or commission that will either be rendered on an individual transaction basis or for a contracted period. Some services may be unique or not widely used, such as those supporting air and water transport where the service may be provided centrally for a region or even a country, for example air traffic control.

Fees will be set based on a number of possible methods, examples of which are:

- according to the amount of time the service has been used, for example car parking;
- on the basis of both the time and volume of the service used, for example storage where the amount of space occupied is an important factor as well as time;
- the number of items on which the service is provided, for example cargo handling services provided for freight in containers or the number of tickets sold by a ticket office;
- the weight of the items on which the service is provided, for example cargo handling services provided on non-containerised freight or passenger baggage;

- a fee fixed in advance for the provision of a package of services over a period of time, for example air traffic control or the service provided by lighthouses.

Data availability

PPIs for warehousing and storage services and for cargo handling services are broadly available. CPIs might be available for a number of these services that are provided to households. Some volume indicators are potentially available, but their coverage is unlikely to be as comprehensive as necessary to capture adequately any shifts between products or changes in quality.

A, B and C methods

The very different ways in which prices are determined for these products makes it difficult to define a classification of methods by product. It is easier to classify methods in terms of the way prices are determined and this approach will be used in the paragraphs that follow.

Where prices are set according to the amount of time used, price indices that reflect the change in unit price will be an A method. The use of volume indicators that are time based (minutes, hours, days, weeks etc depending on the charging period) would be B methods. If pricing is banded into time units with different unit prices for bands, ie the two-hour rate is not twice the one-hour rate, volume indicators would need to reflect these bands to be B methods.

For services where the charge is dependent on both time and volume, price indices would need to reflect these characteristics to be A methods. Where many rates are available for a service charged in this way it may be more appropriate to use model pricing and this would also be an A method providing the models were representative of the full range of services produced. Volume indicators would need to take account of both the time and the volume, for example, volume indicators for storage should be measured in cubic metre days or an equivalent that related to the charging method used for the supply of the service.

Where the service charge is directly related to the number or weight of items on which the service is provided, the use of appropriate price indices would be an A method provided account is taken of changes in quality or a B method if not. Volume indicator methods that relate to the number or weight of items handled would also be a B method.

Where services are provided against payment of a fixed fee the use of appropriate price indices would be an A method. The use of model prices would also be an A method providing the models are representative of the full range of services provided. Changes in quality can be an important factor for services provided by a fixed fee and if this is not reflected in the price indices their use would be a B method. Volume indicator methods would also need to take account of changes in quality to be B methods.

4.8.3 CPA 53 - Postal and courier services

Key aspects

This product group covers postal services under universal service obligation and other postal and courier services .

For most types of postal services the price is determined by a range of factors, such as size of packet, weight of packet, speed of delivery and destination. The price for other postal services, such as post-restante or mailbox rental, are usually set on a fee or transaction basis. Price tariffs can be complicated because of the range of different products offered, but they are readily available for the household consumer.

Prices for business customers are more likely to be based on contract prices that are more difficult to measure and may require a model pricing approach. It is also necessary to take account of discounts for business users. Discounts may be based around such diverse factors as the quantity of the service consumed or the fact that the business customer pre-sorts the post before it is handed over to the postal company for delivery.

Data availability

PPIs are widely available. CPIs are generally available. Volume indicators are available for the services of the National Post although these may not be at a sufficient level of detail to ensure homogeneous products.

A, B and C methods

The use of appropriate and representative PPIs that take account of quality changes would be an A method. For PPIs to be considered appropriate and representative they would need to cover the full range of services produced and take account of any discounts. The use of a CPI for post services, adjusted to basic prices, would be a suitable A method only for that part of output provided to households.

PPIs that do not cover the full range of services or do not take account of changes in quality would be a B method. UVIs for truly homogeneous products, would also be a B method. Volume indicator methods based on detailed indicators of the many types of services provided, for example number of letters/parcels broken down by different postage rate, are B methods.

The use of detailed CPIs to deflate output other than that consumed by households can be a B method if price developments can be shown to be similar for households and businesses. However, CPIs are unlikely to be suitable for the full range of postal services, because of the availability of discounts and the different range of products consumed by businesses. Using detailed CPIs for business purchases where it is known that businesses receive discounts or purchase a different range of products than households would be a C method.

4.9 CPA I – Accommodation and food services

Key aspects

The accommodation and food services heading covers the provision of accommodation (from campsites and youth hostels to expensive hotels) and food services, including the output of bars, discotheques and work canteens. The basic product (a room, meal or drink) is often bundled together with other services such as room service and breakfast in a hotel, and music or other entertainment in a bar. It is therefore important that any services that are not included in the price are classified and measured separately. An example would be laundry services in a hotel, which are usually optional extras for the guest, and should be measured under CPA S.

There are three major issues to be considered when compiling data for these services:

- *Quality* – The wide coverage of this product heading means that very different qualities of products are included – youth hostels and five star hotels, take-away kebab stalls and Michelin-rated restaurants. Proper price and volume measurement would imply that the greatest possible product detail is obtained in the data, so that separate prices *and* values are collected, and any aggregate data are constructed using appropriately weighted subsets. For example, in hotel services, separate collection of data for different ratings of hotels enhances the measurement of price and volume movements.
- *Group bookings and discounts* – One common feature of the hotel trade is that there can be considerable discounts available for block bookings, for example when a tour operator purchases a block of rooms for a season. Changes in these *discounts* should be viewed as a price effect and recorded in the price index.
- *Household and Business consumption* – Whilst the product consumed is unlikely to differ for household and business consumption (business people and private persons can stay in the same hotels and eat in the same restaurants), it is possible that the weighting structure will be rather different, with private persons consuming a greater proportion of the cheaper products. Of course, the discounting of rooms for tour operators could mean that some private persons can afford higher quality rooms than they would be able to afford at the regular hotel price.

Data availability

Price data on the accommodation and food service industries are collected as part of compilation of CPIs, whilst value data are collected from surveys of businesses in the industry. PPIs are rare particularly in those areas of the industry characterised by many small producers (such as the cheaper end of the takeaway market), and often cover only part of the product heading.

Volume data are often available for “bed-nights” in accommodation and “meals served” in restaurants, but the level of detail is usually not very high.

A, B and C methods

Where PPIs are available which meet the general criteria set out in section 2.3, deflation of output by these indices at an appropriate level of detail is an A method. If the PPIs are only partially representative, or do not completely reflect quality changes, this becomes a B method.

Use of the CPI data adjusted to basic prices is considered an A method where it can be shown that prices for business people and private consumers move in a similar way and the compositions of consumption are comparable. Where studies indicate that the price movements or weights differ significantly, use of the adjusted CPI data becomes a B method.

It may be that for some areas, the variety of goods and services bundled with the standard product is such that it is difficult to isolate price movements (for example where entertainment is provided along with a meal or drink). It may be appropriate here to employ a model pricing method, as described in section 2.5, and this could represent an A method if the conditions set out in that section are met.

Use of volume indicators such as “bed nights” and meals sold are B methods so long as the breakdown by type of product is sufficiently detailed to give confidence that major variations in quality are captured.

Any method based on the use of input data, or crude volume data (such as number of clients in a hotel or bar), is a C method.

4.10 CPA J – Information and communication services

CPA J covers a wide range of products including publishing services, motion picture services, programming and broadcasting services, computer services and information services. These are discussed in turn.

4.10.1 CPA 58 - Publishing services

Key aspects

Publishing services includes traditional printed books, as well as on-line books, newspapers, computer games (both packaged and downloads) and software (packaged and downloads),

Some of these services are for business use only, while others can be purchased by both consumers and businesses. Prices should be observable for both, either through the CPI or PPI (although not mandatory in Europe). Packaged software are usually standard products, either system or application software, and prices should be observable.

ESA 2010 recognises computer software as an intangible fixed asset, and as such expenditure on software should be recorded as gross fixed capital formation. This includes a significant share of software produced on own account (to be valued at basic prices). Hence, expenditure on software - which is ever increasing - adds directly to GDP, and the choice of deflator for software has a direct effect on the volume growth of

GDP. This can be compensated however if a large share of the software is imported and the same deflators are used for those imports.

An increasingly important phenomenon is the supply of free software, for example via the internet. There can be various reasons for supplying software for free. A company could use it as a "loss leader" (the loss will be very small anyway since the marginal cost of producing extra copies of software is virtually zero) to generate purchases of other software or to generate internet subscriptions. In other cases, the software is in fact funded by advertisement, either in the software package itself or on the website it can be downloaded from. See section 3.2 for more discussion of the treatment of free output funded by advertising.

Software packages are continuously being developed. New versions with more functions than the previous one are frequently brought on the market. These appear often in the form of upgrades, which should be seen as a different product than a complete version of the package. Nowadays, software can also be purchased via the internet at lower prices than in a retail shop. These different outlets have to be distinguished when constructing price indices. Also, for businesses, the price of the software often depends on the number of user licences purchased rather than the actual number of copies of the software.

These quality changes are still taking place at a very fast rate (although on the average probably not as fast as for computers), making proper quality adjustments for software very important but also very difficult to implement. Whereas for computers, the quality can be determined by their technical characteristics, for software those determinants are much more difficult to recognise. Furthermore, new software versions usually require more system resources in terms of memory size, hard disk, monitor, etc. Should this be seen as a quality improvement or deterioration?

The market for operating systems and general office applications is rather dominated by one large enterprise. This raises doubts about the competitiveness of the market and hence about the usefulness of market prices for evaluating quality changes. On the other hand, good coverage of the market is relatively easy to obtain.

As discussed in section 3.2.2, the price of newspapers may be reduced by the advertising income. In this case, a price index would need to reflect the advertising rates charged by the newspaper and a volume indicator the quality and quantity of advertising space sold. It would be conceptually wrong to apply a price index that reflects the cover price of newspapers or software that are actually purchased, such as the CPI for newspapers. This is because the price development of the advertising space being sold is unlikely to be the same as that of the cover price of newspapers. If data is available, the advertising revenue should be recorded as a secondary product and recorded under CPA73.

The same issue will also apply to some computer software, where the price to the consumer is reduced because of the advertising that is included in the "package". The

price index in this case should also reflect the advertising rates charged by the software provider and a volume indicator the quality and quantity of advertising space sold.

Data availability

CPIs may include packaged software. They may also implicitly include software purchased together with computers in the CPI for computers.

A, B and C methods

For packaged software, the A method is to deflate with an appropriate PPI. Quality changes play a significant role, so an appropriate quality adjustment procedure (e.g. based on hedonics) is essential. It is doubtful whether a CPI for packaged software can give a reasonable approximation of the output price. The business market for packaged software is quite different from the consumer market. For example, businesses buy licenses in large quantities and can therefore obtain discounts. Hence, although a CPI can be used to deflate household consumption of software, it will be a C method for the deflation of output. There are also two different groups of business purchasers, those that buy software for inclusion in their own products which is intermediate consumption (e.g. a computer manufacturer who bundles software with their hardware) and that purchased for use directly within the business (capital formation). The prices for these business purchases will be different and PPIs need to reflect this adequately for them to be considered suitable as an A method.

Less appropriate PPIs will be B methods.

In view of the differences in the speed of quality changes, the use of an index for hardware to deflate software should be called a "C" method.

4.10.2 CPA 59 - Motion picture, video and television programme production services, sound recording and music publishing and CPA 60 - Programming and broadcasting services

Key aspects

The major part of this group of products is the production of original films, TV and radio programmes (where each product is unique).

Certain of these products may be provided without charge to the user, or at a charge which is significantly below production costs. This issue is discussed in section 3.2 of this handbook, where a suitable recording method is suggested.

Data availability

Data on production of films and programmes is difficult to collect. It may be possible to use "model pricing" methods, where a standard TV or radio series is priced by production companies (see section 2.5 for further discussion). Within Europe, the annual AUVIS (audio-visual) questionnaire collects data on production of radio, TV and cinematic programmes.

A, B and C methods

Possible B methods for film and TV/radio programming production are to collect prices for certain model products (e.g. half an hour of a domestic TV comedy, an hour of a radio documentary), or to use quantity data on programming broken down by major categories of programme and weighted by the share in value of total programming.

4.10.3 CPA 61 - Telecommunication services*Key aspects*

Telecommunication services are an area with a wide range of products that are developing quickly. Products include fixed lines, mobile phones, internet service provision, voice over internet telephony, and home programme distribution. Whilst the charging mechanisms employed are often very complex they are based around three broad elements - a 'one-off' connection fee, a regular rental charge and a usage (call) charge. Not all three charging elements necessarily apply to all products, for example there may be no 'one-off' connection fee for some products or there may be no charge made for the actual use made.

The charging elements used are often arranged in different combinations to target particular groups of users, for example a low rental with high call charges for low use (household) customers or a high rental with low call charges for high use (business) customers. The creation of these many different packages, and their continued evolution, is one of the factors that make the measurement of prices for telecommunications difficult.

Technological developments bring about changes in the quality of products. These developments are particularly rapid in the area of telecommunication services. This makes it important to ensure that any changes in quality are adequately reflected in whatever methods are used. For mobile phone services the use of hedonic methods may be seen as a suitable way of ensuring that the many quality changes that occur both often and quickly are adequately captured.

Discounts are another important factor that need to be reflected adequately in any method to ensure the correct measurement of price and volume. Again discounts are designed by the telecommunication service providers to target the many different kinds of user of their services. For example, discounts are offered to high volume business users whilst at the same time low user discounts are also available. Discounts can also be designed around a specific type of usage, for example the offer of a cheaper call charge for certain telephone numbers identified by the customer. Discounts may be offered in terms of extra minutes, texts or additional bandwidth, rather than a simply reduction in price. This may be difficult to price, as such discounts may not affect the price of the service, but the capacity has increased. An additional problem when considering discounts for telecommunications services is the actual take up of the discount by customers, as they are not provided automatically. Producers of telecommunication services often require their customers to register for a particular

discount scheme before the actual discounts are made available, resulting in not all customers actually receiving the discounts on offer.

The bundling of products is also an issue that needs to be considered for this product group, particularly for mobile phone services. It is becoming more and more common for the mobile phone handset to be bundled into a package with the communication service. The handset can be offered without direct charge, at a price less than its full value or at its full value, each of these handset pricing options being linked to different charging mechanisms for the telecommunication service. The primary aim of offering the handset at low or no charge is to reduce the initial cost of access to the telecommunication service. The telecommunication service provider then recovers the cost of the subsidy they have made on the handset through higher rental and/or call charges. The customer is usually required to enter into an agreement with the telecommunications provider to subscribe to the phone service for a minimum length of time, to ensure the provider recovers the subsidy they have made on the handset. When constructing price or volume indicators these bundled products should be considered as different products. This bundling is no different to that seen with other products, for example computers and software and can be treated in similar ways, see section 4.8.6. An interesting secondary issue to consider with a bundled product is to which product group it should be related, for example is a bundled mobile handset and telecommunication service a telecommunication product (a service) or a handset product (a good). In the case of a bundled handset and telecommunication service it seems sensible to consider this a telecommunication product as the motivation for acquiring the handset is to make it possible to use the telecommunication service. Any quality change associated with the handset that is provided as part of such a bundled service would then need to be correctly reflected in the price and volume measures of the telecommunication service.

Pricing telecommunication services may be affected by wholesaling arrangements between the service provider and the owner of the network/infrastructure. Similarly tailored packaging will make tracking prices for a representative proportion of the services provided difficult.

Internet service provision (ISP) consists only of the provision of services necessary to access the internet. This product does not include other services associated with the internet such as web hosting, domain name registration or the provision of advertising which are part of professional, scientific and technical services. ISP is an interesting element of this product group. This is not only because the product is relatively new and developing rapidly, but also because of the creation of new charging mechanisms and the bundling of this product together with others. For example, some companies make the ISP product available without charge to the user or they bundle it together with telephone services. Whilst the introduction of these new products creates challenges for the correct measurement of price and volume, they present no new conceptual problems. The provision of ISP without charge to the user can be seen as no different from that of 'free' newspapers, television or software and the recording in the accounts should be similar. Further detail on the treatment of products provided without charge

to the user can be found in section 3.2. The bundling of ISP with other telecommunication services is also no different from bundling of other services, such as computers and software, or mobile phone calls and handsets, and they should be treated similarly.

Data availability

PPIs are available in most countries, CPIs are more widely available although their coverage is often limited to only fixed line telecommunication services. A number of methods have been studied and a unit value approach has been shown to be feasible and to provide acceptable results.

A, B and C methods

When considering the suitability of methods it is important to ensure that indicators are fully representative of the products and the full range of charges made. For example, where the provision of the service is dependent on the payment of a connection charge, regular rental payments and individual call charges, these will all need to be reflected in the indicators used if they are to be considered suitable.

The deflation of output by quality adjusted PPIs would be an A method. The use of CPIs, adjusted to basic prices, for the output consumed by households (for example television cable services) would also be an A method. In constructing price indices it is important to ensure that the weights used are up-to-date and that the coverage of the individual prices is representative of the full range of output. This is especially true for telecommunication services where products change rapidly.

The use of PPIs where their coverage does not exactly match the products or where there is no adjustment for quality is a B method. UVIs for products that are entirely homogeneous would also be a B method. The use of volume indicators that reflect the full range of outputs is a B method.

The use of detailed CPIs to deflate output other than that consumed by households can be a B method if price developments can be shown to be similar for households and businesses. However, CPIs are unlikely to be suitable for the full range of telecommunication services, because of the availability of discounts and the different range of products consumed by businesses. Using detailed CPIs for business purchases where it is known that businesses receive discounts or purchase a different range of products than households would be a C method.

4.10.4 CPA 62 - Computer programming, consultancy and related services

Key aspects

CPA 62 Computer and related services can be roughly subdivided into a number of services according to their price mechanism:

- Computer programming services (62.01)
- Computer consultancy services (62.02)

- Computer facilities management services (62.03):

Repair services of computers are included in CPA 95. Computer software is included in CPA 58.

Some of these services are for business use only, while others can be purchased by both consumers and businesses.

Bundling computer services with hardware is now the norm. The most evident example is the bundled sale of PC and operating system, but also in the business market software is increasingly incorporated into industrial machinery or maintenance contracts are part of the package. The present product classification does not recognize this bundling problem, which may create problems in measurement.

For example, it can be assumed that the data on household consumption of personal computers will include expenditure on software purchased together with the PC. However, software is usually produced separately from the hardware (and classified in CPA 58). Hence, the data sources on production and consumption will differ in their content. The same holds true for the data sources on prices of production and consumption of computers and software: producer prices will usually separate hardware from software, while consumer prices will often combine these. The problem is acute in particular when the 'packaging' is done by wholesale or retail traders, since then in principle there is no producer of the bundled product.

Most of the software included when buying a PC will also be available separately. One cannot however take the price of the software if purchased separately as an indication of the share of the software in the price of the PC, since bundled software is usually sold at discounted prices.

One suggestion to deal with this problem in compiling national accounts is to introduce at the working level one or more special product groups for the combination of hardware and software. This would make it easier to balance the accounts. However, in the end the combined product will have to be either separated again to compile the supply and use tables, or included in either hardware or software. An alternative could be to regard the packaging of hardware and software as a specific transformation process resulting in a new product. However, the general classification rules concerning assembling would not support such a solution.

In any case, it is important that for the deflation of whatever product the price index used is relevant for that product. Thus, if household consumption of PCs contains a fair share of software, the price index used for deflating that expenditure should take this into account, and should measure the price change of the combined product. That means for example that changes in the software provided with the PC are to be treated as quality changes of the PC.

Data availability

An increasing number of price indices for computer services are currently available. In some countries second-best solutions are employed, such as input-indicator approaches (use of wage rates, number of employees).

In relation to the availability of suitable data on computer service prices, there is an important distinction between standard (non-customised) products and customised products. Prices of standard products (e.g. packaged software) can be collected relatively easily, through observations of actual transactions or, alternatively, through magazines or on the internet. Customised products are unique, and therefore product definition and price measurement are much more difficult (see section 2.5).

A, B and C methods

In view of the increasing importance of investment in information and communication technology in general and computer services in particular, it becomes more and more urgent to develop high-quality price indices for these services.

For customised services (both hardware and software consultancy) an approach based on "representative pricing" (see section 4.13.1 on legal services) could be explored and has the potential to constitute an A method. Another A method could be an approach based on model pricing, i.e. an approach based on asking producers to price a "standard service", as long as the models are representative. In practice, due to the difficulties in defining representative models, model pricing will usually be a B method. The result of the model pricing approach could also be used as a proxy for the price of software produced on own-account (B method), if it can be shown that the own-produced software could also have been produced by an external company.

For the service of renting out programmers on a per-diem basis, as a B method the charge-out rate could be used.

4.10.5 CPA 63 - Information services*Key aspects*

Information services include data processing, hosting and related services; web portals and the output of news agencies. There are a number of private companies providing these services.

Web portal and news agencies services are often provided on a subscription basis, but there are also some industry-level organisations such as Press Associations. The output of freelance journalists and cameramen also counts under this product heading.

The number of news items released could be seen as a suitable indicator for the output of news agencies. Whilst the individual news items are unique, there may be a classification system for the quality of the material (which then determines the price) and the overall volume of product (whether as "column inches" or number of photographic images).

Data processing is normally charged on a per unit basis, while hosting will also be provided and charged according to the service provided. While some may be standard packages, others are likely to be bespoke, so that they become complex to measure. In addition, as web services improve (such as through improved bandwidth), it becomes important to measure quality change.

Data availability

Where the news agency business is dominated by a few large firms or associations, data collection should be relatively straightforward, and use can be made of quality and volume indicators used by the firms for their own internal management. Measuring the output of many freelance journalists and cameramen is much more difficult – the only reliable source is the newspapers and magazines accepting the information, but reporting this input separately would be a considerable additional burden.

PPIs for data processing, hosting and related services, and web portals are available in some countries.

A, B and C methods

The A method for web hosting and news agency services is to use a model pricing method based on subscriptions. The model pricing method should conform to the general principles set down in section 2.5, particularly for representativeness (the range of models should cover the major subscription types). Clearly, this method may be suitable only for some news agency activities.

The B method for web hosting and news agencies is to use quantity and quality indicators employed by the firms themselves to measure output, so long as these can reasonably be compared across the industry and are stable in definition from one period to the next.

The A method for data processing, hosting and related services is to use a model pricing method based on the volume of data being processed or the volume of storage provided, covering the range of services provided under this category. The B method would be to use the quantity information from the companies directly.

4.11 CPA K - Financial and insurance services

The products and services provided by financial intermediation are many in number and can be subject to rapid change as customer requirements and market conditions develop. Output, at current prices, for the part of financial intermediation that is indirectly measured (FISIM) and for insurance is measured by convention in the national accounts. These conventions make measurement in volume terms even more problematic, especially where quality change is considered an important factor.

4.11.1 CPA 64 - Financial services, except insurance and pension funding

Key aspects

The output of financial services can be seen as the activities associated with the management of accounts, loans and saving and investment instruments. When considering suitable methods for the measurement of prices and volumes for financial services it is helpful to look at the different possible methods of charging for these products rather than the individual products themselves. This is because different methods of charging can be used over time for the same product or by different countries. For example, it is possible to offer cheque account services either by direct charges for each individual transaction, by some indirect method that is not directly related to the service provided, or a combination of the two. In this way banking enterprises can in some way hide the real cost of the services they provide from their customers.

The output of financial services consists of two main components: financial intermediation services directly charged by financial intermediaries to their clients (measured as the sum of fees and commissions charged) and FISIM, the English acronym for “financial intermediation services indirectly measured”. Though FISIM is still the largest component by far in Member States, the importance of fees and commissions is increasing over time. As far as volume measurement and deflation are concerned, FISIM causes some major conceptual and practical problems. This is related to the way FISIM has been defined and has to be calculated.

In considering methods suitable for these products it is appropriate to consider FISIM separately.

Financial intermediation services indirectly measured (FISIM)

FISIM can be defined as the value of financial intermediation services that are not charged for explicitly. Financial intermediaries pay lower rates of interest than would otherwise be the case to those who lend them money and charge higher rates of interest to those who borrow from them. Differences between the reference rate (a ‘virtual’ interest rate between the two effective interest rates) and the effective rate on loans or deposits represents the margin earned by the financial intermediary.

Financial intermediation outside FISIM

Apart from FISIM, output of financial intermediation services consists of selling products for which fees or commissions are charged directly to the customers, just as for other products. Fees and commissions can take a number of forms, such as:

- A flat rate fee for a transaction or service. For example, a charge for the provision of a credit/charge card or a handling fee associated directly to a financial transaction;
- A fee based on the value of a transaction stock or flow, ie ad valorem charge. For example, the fee for the management of an investment fund is likely to be linked

directly to the value of the fund whereas the fee charged for the sale of a security is linked to the value of that sale.

- A combination of a flat rate fee and ad valorem charge. For example, the charge associated with the conversion of one currency into another where the total charge to the customer can be on the basis of a flat rate fee and a percentage of the value of the currency being converted.

Change in quality is a factor that needs to be reflected adequately in any method employed. The length of opening hours for bank branches, the proximity of a local branch, the availability of direct access to a full range of services and products, the quality of investment advice and the performance of investment fund managers are some of the features that determine quality for financial intermediation services.

One exception where direct charging is not appropriate is the central bank. ESA 2010 par. 3.63 explains that the output of the central bank is measured as the sum of its costs.

Data availability

Financial intermediation services are not well covered by price indices. Some CPIs do exist, but these relate only to the prices charged to households and are unlikely to reflect adequately the range of services and charges made to businesses.

Volume indicators are more readily available and are being used by the Netherlands in their calculation of volume output for banking services.

A, B and C methods

To allow the classification of methods it is helpful to consider services provided using charges from fees and commissions separately from FISIM. The use of a combination of direct and indirect charges by financial institutions creates a problem for accurate price and volume measurement because over time there may be a move away from the use of FISIM to direct charges or vice versa. The impact of this problem can be reduced by keeping the base year and weights for the FISIM calculation up-to-date. In this way the base period margin being applied (in the reference rate approach, see below) or the weight given to the detailed volume indicators (in the output indicator approach, see below) better reflect any change between the use of direct charges and FISIM.

Financial intermediation services indirectly measured (FISIM)

The following method is a B method.

Volume estimates of FISIM are calculated using stocks of loans and deposits deflated to base period prices using a general price index such as the implicit price deflator for domestic final demand.

The price of FISIM has two components: the first is the difference between the bank rate of interest and the reference rate (or the reverse in the case of deposits) which

represents the margin earned by the financial intermediary; the second is the price index used to deflate the stocks of loans and deposits to base period prices.

FISIM in volume terms are calculated as follows:

FISIM in volume on the loans granted to the institutional sector = (FISIM on the loans granted to the institutional sector) / price index * base period margin / effective margin

FISIM in volume on the deposits of the institutional sector = (FISIM on the deposits of the institutional sector) / price index * base period margin / effective margin

Base period margin on loans = the effective interest rate on loans less the reference rate.

Base period margin on deposits = the reference rate less the effective interest rate on deposits.

In nominal terms, the effective margin is equal to the ratio of FISIM to stocks, so replacing the effective margin by this expression in the two above formulas gives the following:

FISIM in volume on the loans granted to the institutional sector = stocks of loans granted to the institutional sector / price index * base period margin

FISIM in volume on the deposits of the institutional sector = stocks of deposits of the institutional sector / price index * base period margin.

Financial intermediation outside FISIM

When separate prices exist for any charged services, using an output price of a representative set of those services as a deflator is an A method. If quality is an important contributing factor, this will need to be reflected in the price indices used to be an A method. The use of price indices without quality adjustment would be a B method. To be considered representative, price indices must cover a major part of the entire range of charged-for services. Where the activities are highly heterogeneous (eg retail banks, merchant banks and saving banks act very differently) the set of services must be selected for each part of the market for them to be considered representative. Not taking into account those differences is a B method. The price of packages of products may be included if they contain similar services throughout the market. When this is not the case a hedonic method or a model price approach are appropriate for comparing the price of those packages. The use of detailed volume indicators that reflect adequately the output would be B methods.

For ad valorem charges it is possible to construct price indices that reflect both changes in the percentage charged and the changes in value of the underlying asset (stock or flow) to which this percentage rate is applied. This is an A method. The use of volume indicators that reflect adequately the output would be B methods. Examples of suitable volume indicators for different products are:

- For the transfer of funds (payments, etc), the number of transfers or a volume indicator based on the amounts transferred is a B method.
- For money funds, using the amounts managed deflated by a price index that measures the change in the underlying purchasing power of money (as described above in the section on A, B and C methods for FISIM) is a suitable volume indicator.

For financial leasing, the leasing price can mix service charges and FISIM. The decomposition of these two elements into separate parts will therefore be difficult in practice. Where it is possible to separate the service charge from FISIM then appropriate price indices can be used to deflate the service charge element for this to be an A method. However, the use of output price indices to deflate the output of leasing in total should be considered a C method as it fails to measure the output from FISIM appropriately. The value of the outstanding credits deflated by a price index that measures the change in the underlying purchasing power of money (as described above in the section on A, B and C methods for FISIM) would be a suitable volume indicator for a B method. Quality change here relates to the quality of the financial leasing service provided and not to any improvement in quality of the underlying asset. This view of quality for finance leasing is the opposite to that expressed in section 4.14.1.3 for renting services where quality relates to the asset being rented. This is because for finance leasing the service provided relates to the lending of money for the purchase of an asset rather than to the supply of the asset itself.

Output prices or volume indicators that reflect a small limited range of financial products or services, or use of a general price index are C methods.

Services of holding companies (CPA 64.2), trusts, funds and similar financial entities (CPA 64.3) and other financial services (CPA64.9) are similar in nature to head offices (see CPA 70.1 for more information). Little data is available, so the best approach is to apply a detailed input method, in which wages and salaries are deflated in such a way that changes in the composition of the workforce are included in the volume component. This could be seen as a B method here.

4.11.2 CPA 65 - Insurance, reinsurance and pension funding services, except compulsory social security services

Key aspects

The value of insurance and pension funds services is defined at current prices by convention. Output of life insurance is measured as (see ESA 2010, par. 3.74):

premiums earned
plus premium supplements
less benefits due
less increases (plus decreases) in life insurance technical reserves

Output of non-life insurance services is measured as (see ESA 2010, par. 3.74):

total premiums earned

plus implicit premium supplements (equal to the property income earned on technical reserves)

less adjusted claims due

From the definition set by convention, it can be seen that a direct measure of the output price of the service provided is impossible because of the nature of the components that constitute the output. Deflation by an index of gross premiums - a concept used in the consumer price statistics - is a conceptually inappropriate method for the national accounts. This is because the change over time of gross premiums is unlikely to be a good reflection of the changing price of the service charge.

A particular issue for insurance services is the bundling of products, as a number of specific insurance products may be tailored to meet the particular needs of a customer. For example, to offer a package of house and car insurance at a different price to that for the two products if purchased separately.

The output of non-life insurance is slightly different from those of life insurance because of the relatively short-term nature of the risk being transferred or pooled. However, provisions can still be seen as a suitable indicator of risk. Non-life insurance contracts generally are renewed annually with each renewal being a separate contract between the supplier and purchaser. The products that make up the output of the non-life insurance branch are also more heterogeneous in type than those associated with other products in CPA 65. Quality is an important aspect of non-life insurance with the introduction of different methods of purchase (traditional agents, telephone and internet sales methods).

The wide variety of products has already been mentioned and this is a particularly important issue when considering the suitability of volume indicator methods.

Data availability

Structural Business Statistics provide a wide source of data on the insurance industry about the number of policies and the financial activities of insurance enterprises.

CPIs for some types of insurance are available, but are not suitable for use in the national accounts as they do not conform to the required concepts and definitions. This is because these CPIs measure changes over time in the gross premiums for insurance, these are unlikely to be a good reflection of the changing price of the actual insurance service charge.

A, B and C methods

Even from a purely theoretical viewpoint it seems impossible to implement a concept of deflating the service output on the basis of output price statistics. The main reason is

that there is no directly observable price or quantity that is truly representative of the output. An A method is therefore considered not possible.

Volume indicator methods that make use of detailed indicators, such as the acquisition and administration of policies and the administration of claims is a B method. Such a method (sometimes known as the direct service method) requires indicators at a very detailed level that take account of changes in the product mix. Whilst much financial data are available for insurance, this method requires activity level detail on the different services produced together with detailed expenditure information to provide weights. This can be resource intensive to collect. Also, accounting for quality may be difficult.

The use of provisions adjusted for claims deflated by a price index that measures the change in the underlying purchasing power of money (as described above in the section on A, B and C methods for FISIM) is also a B method, as it aims to approximate the transfer or pooling of risk.

For non-life insurance the number of policies, by product (household, motor vehicle, third party liability etc) and type of purchaser, also represent a suitable volume indicator for non-life insurance and is a B method. For life insurance and pension funds these methods are C methods.

4.11.3 CPA 66 - Services auxiliary to financial services and insurance services

Key aspects

These services are generally provided against payment of a fixed fee or ad valorem based charges. It is important to stress that it is the transaction fee that should be measured, not the value of the stock that is traded.

An exception are services auxiliary to insurance services and pension funding where a commission may be paid, usually recovered from the companies providing the actual intermediation service.

Data availability

PPIs for these services generally do not exist and will be potentially difficult to collect because of the large number of different services covered by the group and the limited nature of the product classification. The CPI potentially covers some of these services that are provided to households, but this is not comprehensive. Suitable volume indicators are available, but again these are currently unlikely to cover fully all the services produced.

A, B and C methods

In the case of fixed fees, where separate prices exist for a charged-for service, current price output deflated by a PPI is an A method if changes in quality are reflected or a B method if quality change is not reflected.

For services paid for by ad valorem charges, the use of volume indicators is a B method. The appropriate indicator depends on the activity. Such volume indicators can include number of transactions broken down by value size classes or deflated transaction amounts. For auxiliaries to insurance, volume indicators based on the number of insurance policies by type or deflated gross premiums, using a price index of gross premiums, is a B method.

4.12 CPA L - Real estate services

4.12.1 CPA 68 - Real estate services

Key aspects

CPA 68 consists of three different types of products:

- 68.1 Buying and selling services of own real estate
- 68.2 Rental and operating services of own or leased real estate
- 68.3 Real estate services on a fee or contract basis.

Part of the services in the first group consists of the development of real estate projects to sell. The activities comprise bringing together financial, technical and human resources necessary to realise the projects. Projects can be either residential or non-residential buildings (shopping centre, offices, hotels, etc.). For price measurement, these services are very difficult to measure due to the uniqueness of the projects.

The other part of this group is the buying and selling of own real estate, in essence a trade activity, which the national accounts should record on a net basis.

Letting services of own property include letting of dwellings, non-residential buildings or land. Real estate services on a fee or contract basis are the services of real estate agents that intermediate in buying, selling or letting real estate. As the name suggests, payment is on a fee or contract basis, often as a percentage of the selling price, or – in the case of letting – as a percentage of say the monthly rent. This group also includes the management of real estate on a fee or contract basis.

For deflation of real estate services the distinction between residential and non-residential real estate is very important, since price developments in both markets can be quite different.

Quality changes play a role for real estate services as well. For example, real estate agents can also provide the legal services involved in buying a house, so that it is no longer necessary to use the services of a lawyer. Also, the phenomenon of “multi-listing”, i.e. offering a house through more than one agent, affects the price setting.

A particular practical problem for the measurement of real estate services is the time of recording. In many cases the activity of a real estate agent takes place before he knows what price he will receive for his service. The question is therefore what the "accruals"

point is. The only possible measurement point is the moment the agent sends the invoice. Until then, the activity should be seen as work-in-progress.

It should be noted that a large part of these services is gross fixed capital formation, as part of the transfer costs of buildings.

Data availability

Actual output price indices for real estate services are rarely available yet. Some countries do however have e.g. house price indices or investment price indices for new dwellings. Often volume information is available on e.g. the number of houses sold. For letting services, often CPI information is available on residential buildings. For letting of non-residential buildings, some countries compile PPIs.

A, B and C methods

For services on a fee basis, where the fee is a percentage of a property price, a proper price index would combine the change in fee percentages and the change in house prices. This would constitute an A method. Instead of following actual prices the real estate agents could be asked to quote a price of selling e.g. a standard dwelling. This model price approach could also be an A method provided the models are sufficiently representative. For the development of real estate (68.1), model pricing seems to be the only option, although it will be very difficult to apply properly. In any case, this activity is expected to be relatively small in size.

Proxies (B methods) could be the use of an price index of investments in new dwellings or an index based on property values (house prices). Regarding the latter, since the real estate services are percentages of the property values it is reasonable to think that both are correlated enough to constitute a B method. It is then implicitly assumed that the fee percentage is constant.

Less good, but still B methods, is the use of numbers of houses sold or numbers of transactions of notaries, if broken down by types of houses (e.g. by size). This is probably more appropriate for the trade in property (in 68.1) than for intermediation (in 68.3). A disadvantage is that it is difficult to differentiate the types of activities: real estate agencies are involved in all the services and distinctions are hard to realise. Furthermore, it is difficult to take quality changes into account.

For the part referring to letting of residential buildings, CPI information is usually available; this will constitute an A method, since this output is only consumed by households. For letting of non-residential buildings, the use of PPIs on the basis of e.g. rents per m² office space is an A method, provided sufficient detail is available on different types of buildings and their quality.

Alternatively, the use of volume indicators relating to the volume of the stock of residential or non-residential property could be a B method. It might be necessary in this case to adjust for changes in the ratio of rented/owner-occupied dwellings.

Lastly, the price changes of non-residential buildings could be proxied by the CPI for residential buildings. However, the underlying assumption here is quite unrealistic. Unless the contrary can be shown this is a C method.

4.12.2 Dwelling services of owner-occupiers

Key aspects

The output of dwelling services of owner-occupiers at current prices is in many countries estimated by linking the actual rents paid by those renting similar properties in the rented sector to those of owner-occupiers. This allows the imputation of a notional rent for the service owner-occupiers receive from their property. This calculation is usually only carried out for a benchmark year, as few countries have the necessary data to apply the method on an annual basis. The benchmark is then interpolated and extrapolated using indicators that reflect the change over time in the price of rent and the volume of dwellings.

The benchmark estimate makes use of detailed data on the housing stock broken down between owner-occupied and rented property and by attributes of these properties that influence the rent they can be expected to generate. Examples of these attributes are the floor area, number of rooms, location and the existence of facilities (bathrooms, heating, etc.) of the dwellings. This method is known to some as the 'stratification method' because it is based on the stratification of dwelling attributes and rent. This is the approach agreed by EU Member States for the satisfactory estimation of the output of dwelling services and set down in Commission Decision 95/309/EC. The approach can be seen simply as the use of price and quantity data, at a detailed level, for the estimation of output for a particular year.

Estimates for years other than a benchmark year, are estimated by projecting forward the housing stock and rents with indicators that reflect the development of these variables over time. The indicators are chosen to reflect adequately the three separate components of change: that of change in price, change in the quantity of the stock and change in the quality of the stock.

The stratification method thus contains in its calculation of estimates at current prices all the data necessary for the decomposition of the value of output into its price and volume component. The use of this same price, quantity and quality information to produce estimates at previous year's prices ensures consistency between the final results at current and previous year's prices.

The choice of indicators for the extrapolation and interpolation of the benchmark estimates of dwelling services is an important factor in the quality of the resulting estimate. This is true for the quality of both the current and volume estimates providing the same basic data are used for both. Therefore it could be argued that when the same price index is used for the calculation at previous year's prices as that used in the calculation of the current price estimates, this would be the most appropriate method.

If the stratification method is not used then price indices or volume indicators need to be constructed. Quality changes of the dwellings is an important factor that needs to be reflected in any method to ensure that changes in quality are correctly recorded as part of the volume change and not as changes in price. In constructing price indices, it is also important to ensure these reflect adequately what is being measured by the output of owner-occupied dwelling services. The concept of dwelling services for owner-occupied rents is that these should be related to the actual rents that could be expected from the dwelling. Such a rent is more likely to be comparable with that from private rented dwellings rather than all rented dwellings or only those from the public rented sector that may include an element of social housing. This is because of the possible existence of differential pricing between public and private rented dwellings from subsidies, rent controls or other factors.

Data availability

EU countries apply the stratification method at current prices and therefore have readily available the consistent output price information necessary for deflation. CPIs for rented accommodation are widely available and may also be available split between private and public rents.

A, B and C methods

When the stratification method is used for current prices

The use of the same price, quality and quantity information for the estimation at previous year's prices as for current prices would be an A method.

If different price, quality or quantity information is used for the estimation of previous year's prices to those used at current prices, this would be a B method provided the indicators used were appropriate. The CPI for privately rented dwellings would be an appropriate price index. The CPI for rents where coverage was wider than private rents would also be appropriate providing differential pricing between public and private rents did not exist. The stock of owner-occupied dwellings, broken down in sufficient detail, would be a B method.

The use of the acquisition price of new dwellings would be a C method as this does not relate to the rental income of the dwelling, but to its acquisition price.

When the stratification method is not used for current prices

The use of a CPI for privately rented dwellings that takes full account of changes in quality to deflate output would be an A method.

The use of a CPI for rents where coverage was wider than private rents or where changes in quality were not fully taken into account would be a B method.

The use of volume indicator methods based of the stock of owner-occupied dwellings, broken down in sufficient detail, would also be a B method.

The use of the acquisition price of new dwellings would be a C method as this does not relate to the rental income of the dwelling, but to its acquisition price.

4.13 CPA M - Professional, scientific and technical services

One characteristic that a large part of the services within CPA M have in common is that the service provided is basically one of “knowledge”. A lawyer, for example, can sell his services to others because he possesses specialised knowledge that is useful to other people. The product of the lawyer is the application of this knowledge to the specific case at hand. The same holds for e.g. accountants, architects, engineers, management consultants, real estate agents, researchers, etc. The intrinsic difficulty of defining these services is that this knowledge cannot be easily quantified or valued.

Due to these difficulties, and despite the growing importance of services, statistics in the field covered by CPA M are less well developed than those for the traditional “goods-producing” industries, such as agriculture, mining and manufacturing. Generally it is possible to directly measure the total output of a large part of the services industries in current price terms. It is however not straightforward to identify the individual products of the services industries. This is reflected in the poor development of the product classifications for (business) services.

Within CPA M, due to the characteristics of these services, many products are unique; i.e. they are only produced once. For example, a management consultant may be asked to advise a major enterprise on its restructuring process. Each project of this nature is likely to be different because of the broad range of problems underlying a decision to restructure a business. The output is the advice passed on to the managers of the business rather than the report eventually produced. An approach to pricing which has proven satisfactory in the area of unique goods is to set up a model (e.g. a standard accountancy contract) for which price quotes are obtained in each period (see further discussion in section 2.5).

Even if it is possible to identify outputs in a number of cases, as well as to identify that quality changes have occurred, it is still more difficult to satisfactorily quantify these quality changes. An example would be criminal court cases handled by lawyers. It is possible to identify an output indicator simply by counting the number of court cases classified by type of case. However, the complexity of such cases and the quality of the lawyers’ work in court make it difficult to measure the quality.

4.13.1 CPA 69.1 - Legal services

Key aspects

These services consists of advisory and legal representation, drafting legal documents, and other services like those of justice auxiliaries, receivers, giving legal advice and assistance in registering patents. Consumers are both companies and households. A particular feature is the recording of e.g. notary fees for the transfer of a property as gross fixed capital formation.

The means of remuneration for these services can be very variable: remuneration can be based on contracts, fixed tariffs, fees proportional to the values of the transactions, negotiated fees and, sometimes, results-based fees.

The legal activities industry is particularly dependent on the institutional framework in the various countries. In many countries, for example, a distinction is made between “notaries” and “lawyers”. In English-speaking countries however, the terms “solicitors” and “barristers” are used, where the division of functions differs to that of notaries and lawyers. However, it seems likely that the pricing issues are very similar in all countries.

Data availability

For standard type legal services, such as those usually carried out by notaries or solicitors, CPI information can be available. In addition, the Short Term Statistics requirement is for an aggregate PPI that includes legal (CPA 69.1), accounting (CPA 69.2) and management consulting services CPA 70.2). To meet this requirement, Member states will also be in a position to generate a PPI for legal services.

One other approach that merits a mention is what could be labelled "representative pricing". In this approach, the producing firms are asked to identify a list of representative products or contracts, which stay more or less constant, so that the prices can be followed over time. In fact, such an approach is not far off from normal practice in PPIs for manufacturing products.

A, B and C methods

From the pricing point-of-view, probably the easiest type of legal service is the standard type of service that is mostly carried out for households, such as drawing up contracts for buying houses, wills, marriage contracts, etc. (“notary” services). For such services fixed tariffs often exist; which are often covered by the CPI. An index that follows these tariffs should give a reasonable price index since discounts will be rare. Hence, this can be regarded as an A method. Furthermore, for these standard services, it will be easier to collect volume indicators (number of contracts drawn up, etc.). This will be a B method for those services, unless a method is found to adjust these indicators for quality changes.

In most countries, the biggest part of the output of legal services goes to gross fixed capital formation, being part of the transfer costs of buying property. This can be both by households and businesses, but is nearly always related to the cost of buildings. That means that a price or volume index related to those buildings could serve as a proxy for the price or volume of the legal services. An important aspect in this respect is the relationship between the fee for the legal service and the price of the building. Where a fixed fee is charged, it is sufficient to follow the change of this fee over time. Where the fee is a percentage of the price of the building, the price index should be a combination of changes in the fee percentage and changes in the price of the building. In both cases, it will be a B method, because quality changes are difficult to capture.

For the services to businesses, there are two basic price mechanisms in this market: lawyers can be hired by the hour or for a fixed-rate on the basis of a contract. For the former, charge-out rates or hourly fee approaches can be used as B methods. For the latter (services for a fixed rate on the basis of a contract), an A method would be to closely follow the prices of the contracts, e.g. following the "representative pricing" approach, if the types of contract were homogeneous. A model pricing approach could also work well, and be an A method. It is not easy to envisage volume indicators that could be used for this type of service.

4.13.2 CPA 69.2 - Accounting, bookkeeping and auditing services; tax consulting services

Key aspects

A large part of the work in this CPA class consists of work under contract. Often, the work is of a routine nature, which enables output to be defined and associated quantity indicators to be identified (e.g. the number of individuals' tax returns filed, the number of small business tax returns filed etc). Many auditing contracts are the same year-by-year, so prices can be observed.

However, a significant part of the work will be unique. Such work will be paid for on the basis of charge-out rates, particularly at the upper end on one-off types of jobs such as receiverships, auditing etc.

Data availability

The Short Term Statistics requirement is for an aggregate PPI that includes legal (CPA 69.1), accounting (CPA 69.2) and management consulting services CPA 70.2). To meet this requirement, Member states will also be in a position to generate a PPI for accounting services. The "representative pricing" approach has been explored for these services as well. Some quantity indicators could be readily available, but they will not cover the whole area.

A, B and C methods

The A method for accounting services would be to construct deflators based on contract prices for a range of the most important services provided under contract by accountants, e.g. using the "representative pricing" approach. It would be necessary to regularly monitor the services priced to ensure that external influences such as changes in accounting standards or changes in accounting requirements under legislation (e.g. for taxation returns) would not result in significant changes in the outputs being measured or in changes in the quality of the output. An A method can also be obtained with a model price approach, but it seems that this could be a more costly approach than obtaining a broad range of actual contract prices because of the amount of work required to set up and maintain a broad set of representative models.

Using quantity indicators such as the number of tax returns filed (classified by broad categories) would be a B method for part of the industry. Keeping track of quality changes (e.g. those caused by legislative changes) could be difficult and time-

consuming. However, there are some potentially high-value one-off types of work for which such an approach would not be appropriate.

Using charge-out rates or hourly fees would be a B method since it would miss out some of the productivity changes. Productivity increases could be quite significant for these services because of the high degree of computerisation for a number of the more routine jobs such as filing tax returns.

4.13.3 CPA 70.1 - Services of head offices

Key aspects

These services are by nature only consumed by businesses. They are services of head offices (parents) rendered to subsidiary companies (daughters). Therefore, they take place exclusively within enterprises. There is no real market for these services, and hence there is no market price.

Data availability

Currently, very little data are collected on prices or volumes of head office services. Generally, only wage data are available.

A, B and C methods

Due to the peculiarity of this category of services, there is no A method here. The best one can probably do is to apply a detailed input method, in which wages and salaries are deflated in such a way that changes in the composition of the work force are included in the volume component. As an exception to the general rule, this could be seen as a B method here. Care should be taken that appropriate wage indices are used. It is likely that the work force of head offices consists of a high proportion of high-skilled labour (see section 3.53.11.2 for guidelines on the deflation of compensation of employees).

4.13.4 CPA 70.2 - Management consulting services

Key aspects

These services are very heterogeneous and have in most cases the common characteristic that they are tailor-made for the client, and therefore by nature unique.

Most frequently enterprises work on a contract basis for their clients. This can be either on a permanent basis with perhaps annual contracts, e.g. on public relations services or on contracts on a specific task e.g. consultancy services in connection with reduction of personnel. Working by the hour will be less frequent.

It is often the case that business and management consultancy activities take place in similar or even within the very same companies as legal activities and accounting, bookkeeping, auditing and tax consultancy activities. The cost bearing characteristics of the activities are furthermore probably rather similar.

Data availability

In some cases, business and management consultancy services are included in output price indices of accounting services, since they are often difficult to separate. Very little other information is currently collected about prices or quantities of those services.

A, B and C methods

An A method for these services would be the collection of actual contract prices. It will be necessary to control for changes in quality of the contracts over time and, since the services supplied are very heterogeneous and rather unique from client to client, it is necessary during this price collection process to be in close contact with a large proportion of the different enterprises in the industry.

Collecting model prices would be an alternative to collecting actual prices and the method would also be an A method if it satisfies the criteria set out in section 2.5.

For services carried out on a fee-per-hour basis the charge-out rates or hourly fees could be used to form a B method.

Using as a proxy an actual output price index for either legal services or accounting, bookkeeping, auditing and tax consultancy activities would - due to the common cost determinants for these different services - be a B method.

4.13.5 CPA 71 - Architectural and engineering services; technical testing and analysis services

Key aspects

Architectural and engineering contracts may cover different types of services ranging from a simple pre-feasibility study to a complete study - including the studies for the pilot project, implementation of the project and follow-up of delivery of the project. The services may be limited to simple technical recommendations but may also entail wide-ranging responsibilities. They may also entail, for example, the complete supply of an installation and extend beyond technical assistance to actual exploitation of the system. These services are of a particularly varied nature since they may involve building a hospital, a factory (agro-food, chemical or nuclear), an art installation or a railroad.

CPA 71 also includes mineral exploration. ESA 2010 (par. 3.127) specifies that mineral exploration is to be considered as gross fixed capital formation (acquisition less disposals of intangible fixed assets). 2008 SNA (paras 6.231 and 10.106 – 10.108) specifies that exploration should be recorded as output even if unsuccessful, and that the output is equivalent to the costs incurred in test drilling, surveys, transportation, and other activities.

Data availability

PPIs for architectural and engineering services are now available in many EU countries.

A, B and C methods

Clearly, the majority of architectural and engineering services is unique by definition. Therefore it is not possible to design a single framework that measures the prices of repetitive services, as can be done for other services. Each service possesses its own characteristics and is generally not comparable to a similar service performed previously. For this reason it is difficult to define an A method based on the collection of actual prices. Model prices seems to be a method that potentially could give an A method. The hedonic approach (as developed in Norway) needs further investigation.

Using charge-out rates or hourly fees can be considered in this case as a B method. For mineral exploration an option is to use a volume measure, for example the number of test drills made, or area surveyed, though this would need to be broken down by type of mineral and method of exploration in order to be considered a B method.

4.13.6 CPA 72 - Scientific research and development services**Key aspects**

Research and development (R&D) is carried out by three different kinds of units. They are:

- a) Units which sell their R&D services on the market. They work mostly on the basis of contracts, and are often active in the more practically oriented type of research (for which a market exists). These characterisations are not very precise, since in practice the borderlines are often quite vague. E.g. universities also compete on the research market.
- b) Units within an enterprise producing R&D products for use exclusively within the enterprise or its parent company which will often be a large multinational. The product will not be marketed outside the multinational, and may not be patented, depending on secrecy to preserve its value for the owner.
- c) Non-market units such as educational institutions, public hospitals, and non-profit research institutes of different kinds. The R&D is more often fundamental research, funded by the government.

The activity of R&D is by nature a unique activity that only takes place once. In most cases this makes ordinary price comparisons over time impossible.

The output of the production process is correspondingly difficult to identify in advance. Some research projects end up giving the result that one had hoped for or had expected; others seem to be a dead end or end up giving a very different result than expected: one that might be useless to the original customer but turns out to be very useful in another research project taking place later on. It should be noted that even projects that end up with no useful result have produced output.

The problem with R&D is different from the pricing problem involved in connection with e.g. large equipment. In that case the problem with collecting an actual output price index is that the item in question is actually only produced once. However 'model prices' can be collected since it does make sense to ask e.g. shipyards to price a similar ship in successive periods because it is conceptually possible to build this ship in each of all the periods in question. This does however not apply for R&D projects. An R&D product is a product of knowledge and once this knowledge has been achieved the price of achieving it again in the next period is zero. It is therefore not conceptually possible to construct a model of an R&D project that can be used for collecting 'model prices'.

It can be expected though that the prevailing pricing mechanism for marketed R&D is to price the hours worked by the researchers, i.e. a charge-out rate approach. That means that data on charge-out rates or hourly fees can in principle be collected.

ESA 2010 paragraph 3.83 gives the following guidance on measuring the output of R&D services:

- a) R&D by specialised commercial research laboratories or institutes is valued at the revenues from sales, contracts, commissions, fees etc. in the usual way;
- b) The output of R&D for use within the same enterprise is valued on the basis of the estimated basic prices that would be paid if the research was sub-contracted. In the absence of a market for subcontracting R&D of a similar nature, it is valued as the sum of production costs plus a mark-up (except for non-market producers) for Net Operating Surplus or mixed income.
- c) R&D by government units, universities and non-profit research institutes is valued as the sum of costs of production. Revenues from the sale of R&D are to be recorded as revenues from secondary market output.

Expenditure on R&D is distinguished from that on education and training. Expenditure on R&D does not include the costs of developing software as a principal or secondary activity.

Data availability

The Frascati Manual surveys on research and development will typically gather information on expenditure for R&D services. These will include current expenses, employment and wage rates for research staff, and capital expenditure on assets directly used in the creation of the R&D services. This information is the basis of estimating the value of the R&D through summing of costs, in the absence of marketed output. Reducing these measures to volume terms and weighting them by the value of expenditures gives a measure of volume change over time.

A, B and C methods

In the main, an A method in this case does not exist. Neither collection of actual output prices from e.g. the research institutes nor 'model prices' makes sense since you cannot meaningfully price the same R&D output in two periods in succession. For this reason, input methods are B methods.

For marketed output, charge-out rates, or hourly fees should be collected as much as possible (see paragraph 3.1.1.1 for a discussion on charge-out rates and hourly fees). Deflating these by a general measure of inflation, in combination with an index of average wage rates will give a measure in volume terms. The rationale for using a combined inflation and wage rates deflator is that many services use a high proportion of labour and purchased goods and services in the production process, so both affect the output price. These would be B methods.

For in-house production, wage rates and price movements of the goods and services purchased can be collected, and weighted to give a price movement of inputs. This can be used as a proxy for the implied price of the in-house production. Again this is a B method.

For non-market output, by government or non-profit bodies, the usual methods for producing volume growth estimates of collective services as set out in paragraph 3.1.1.2 are to be used.

4.13.7 CPA 73 - Advertising and market research services

This includes advertising services (CPA 73.1) and market research services (CPA 73.2)

Key aspects

There are two distinct and significant services that form the large bulk of the advertising product. In general terms these are 'Placement' – the selling of advertising space, whatever the media; and 'Creation' – excluding associated costs such as film production or photography services.

The pricing mechanism for 'Placement' can be readily identified as price per second for TV advertising; cost of a half page newspaper advert, the price of a square metre of billboard space or the price of a "banner" on a web-page. Prices for all of these activities should be available. It is important however to take into account changes in the number of people that see the advert. An advert in a national newspaper (large circulation) is a higher quality product than an advert in a local newspaper (small circulation). If advertising space is produced to fund another activity that is provided for free or at a low charge (e.g. providing internet access, television programmes or football matches), the number of users/viewers should be used in the estimation of the volume of the advertising output and therewith in the estimate of the output of the internet service provider, television producer etc. See section 3.2 for a further discussion on the treatment of free output funded by advertising.

The mechanism for 'Creation' is a little more difficult to define since it relates to the creative thinking and planning that results in the final product, but not the associated market research or subsequent production of the advert. In practice it is often difficult to separate production costs and creative thinking.

Data availability

As said above, prices for placement activities are in principle observable. For creation activities, there is very little price information collected.

A, B and C methods

The A method for 'Placement' is self-evident. That is to collect actual contract prices, using quotes for the activities defined above, but also including other media such as consumer magazines; telephone directories; radio; cinema; and transport advertising. As said above, it is important that the number of viewers of the advert is taken into account as a quality aspect. At least some attempt should be made to adjust for 'peak-time-viewing' differentials. Model prices would also be an A method, although it does not seem to be necessary to use these since actual output prices should be available. Quantity measures could also be used but these would need to be compiled at a very detailed and representative level with quality changes accounted for to be an A method.

For 'Creation', in principle, it should be possible to collect contract prices. The product is arguably standard when considered in the context of quotes such as the creation of a two-minute television advertisement; one-minute radio advert; or new company name. The difficulty is that the pricing mechanism normally includes the associated market research and production costs. If contract prices can be collected, then these would form an A method, however care would need to be taken in the interpretation of the collected prices to ensure they did not include production costs. A model prices approach could also be considered as A, if it satisfies the criteria set out in section 2.5. Charge-out rates or hourly fees are related to the actual output in so far as 'creative thinking' involves little intermediate consumption or capital and is, in the main, human-resource-intensive, and so these should be viewed as B methods.

All other approaches are C methods.

Market research services will have aspects of research and development, although generally it will be more standard and continuous, and therefore easier to price.

4.13.8 CPA 74 - Other professional, scientific and technical services

This includes specialised design services (CPA 74.1), photographic services (CPA 74.2), translation and interpretation services (74.3) and other professional, scientific and technical services n.e.c (74.9).

These categories will include a mix of standard services for which prices in principle can be collected, but also some services of a unique nature.

Other professional, scientific and technical services n.e.c are an amalgam of special types of services that will usually be of a unique nature.

4.13.9 CPA 75 - Veterinary services

Almost all of these services are provided as market services so that the use of the appropriate component of the CPI is the recommended approach. If an adjustment is made to basic prices this is an A method, if not a B method.

4.14 CPA N – Administrative and support services

This covers rental and leasing services, licensing services for the right to use intellectual property and similar products, employment services, travel agency services, security and investigation services, services to buildings and landscape and office administration.

4.14.1 CPA 77 - Rental and leasing services

CPA 77.1 – CPA 77.3 Rental and leasing services of goods

CPA 77.1 - Rental and leasing services of motor vehicles

The output of this group is relatively easy to define. However the market situation of the private customer usually differs from that of a business customer. Most private customers rent cars by the day or for a relatively short period of time. Businesses rent cars for shorter periods of time but for longer periods too; where contracts tend to be used. Obviously the prices may differ for the different kinds of customers but the price is observable and easily defined.

CPA 77.12 - Rental and leasing services of trucks;

These services are almost exclusively directed towards businesses and a renting contract is in many cases unique for the company in question and of a one-off character which makes ordinary price comparison over time difficult.

CPA 77.2 - Rental and leasing services of personal and household goods

These services are exclusively supplied to households and are often standard services, which makes ordinary price collection possible.

It is worth noting that CPA 77 explicitly excludes financial leasing activities so that only the activities concerning operational leasing remain.

Data availability

For renting services to households, generally CPI information is available. Problems of data availability exist in particular for renting of equipment and machinery. Only a few countries are trying to compile actual output price indices for these renting services.

A, B and C methods

An A method for these services would be to collect actual rental prices. For services supplied according to a contract it is necessary to control for changes in quality over time. Furthermore, since the services can be unique, from client to client, close contact with the different enterprises in the industry is needed. It should be noted that changes

in the quality of the item rented (i.e. not only of the rental service) should also be reflected in the volume of the rental services. For unique services, the use of model prices satisfying the criteria specified in section 2.5 would also be an A method.

Regarding services supplied only to households, CPI information will often be available, and in that case making use of a CPI, adjusted to basic prices, will be an A method for deflating output. In the cases where services are supplied to both businesses and private households, use of a CPI to deflate output will be a B method since it only covers the consumer market.

If no observable price of the rental service exists the price index of the actual product can be considered a B method: on the assumption that there is a correlation between changes in the price of the item and changes in the rental price of the item.

CPA 77.3 - Rental and leasing services of other machinery, equipment and tangible goods

These services are almost exclusively directed towards businesses and a renting contract is in many cases unique for the company in question and of a one-off character which makes ordinary price comparison over time difficult.

CPA 77.4 - Licensing services for the right to use intellectual property and similar products, except copyrighted works

This includes CPA 77.40.11 Payments for use of R&D

The asset boundary has been extended in ESA 2010 to include the products created as a result of Research and Development. Where these products are used in-house, then the capital services provided as the product is used in future production are represented in the national accounts by the consumption of fixed capital, but with no allowance for a return to capital except for non-market producers. These in-house capital services cannot be measured reliably at present and remain an unidentified component of gross operating surplus.

Where the R&D product is made available to other users through a licencing system, then the fees paid for the use of the products are service payments and can in principle be broken down into price and quantity components. However, as described earlier in paragraph 4.10.5, the unique nature of R&D products, prevents general price movements being estimated. It is therefore proposed that service payments for the use of R&D are deflated by a general price indicator of the economy such as the PPI.

4.14.2 CPA 78 - Employment services

Key aspects

Recruitment agencies largely charge businesses in one of two ways. In the first the employee is paid directly by the recruitment agency and to that extent output includes the wages of the employee. In the second the employee is paid by the business rather

than the recruitment agency and so the output of the agency records only the recruitment costs: usually a percentage of the achieved salary.

In both cases a breakdown between the types of labour supplied is necessary. For example, distinctions between supply services of office personnel and industrial workers should be made.

Data availability

Generally, data on wages should be available. Data on fees are probably more difficult to get. Producer price indices of employment services have been developed in many EU member states.

A, B and C methods

Where the employee is paid by the recruitment agency, methods based on wage rate indices relating to the personnel hired out seem to readily lend themselves as B methods. An A method would include productivity and quality adjustments and also reflect the administrative costs imposed by the recruitment agency. To that extent contract prices, which include quotes for specific types of workers, would be A methods, provided quality changes are properly accounted for. Model prices could also constitute an A method, if properly done.

Where a percentage of the salary applies the above methods and classifications apply except in this case they should be combined with information on percentage fees. If information relating to percentages is not available then the use of wage rate indices could be considered a B method. It is then assumed that the percentage does not change.

4.14.3 CPA 79 - Travel agency, tour operator and other reservation services and related services

The output of travel agency services needs to be considered differently from some other services included in this product group. The full cost incurred by the purchaser of the travel is not the output. Output can be considered as being derived from either a direct charge (if a fee or commission is charged) or as the difference between the full payment made by the final purchaser and the total of the expenditures made on the various elements of transport and accommodation provided.

The output of tour operators on the other hand is the full expenditure made by the purchaser. They can be considered as the purchaser of a number of different services that are repackaged into one final product for consumption, for example, the provision of an air ticket and hotel accommodation. Methods used for prices and volumes will need to reflect this.

4.14.4 CPA 80 - Security and investigation services

Key aspects

The most frequently occurring situation for the largest part of the output of these services – for example surveillance and guarding services – is that enterprises work under a continuous contract for a client. Sometimes guards can be hired by the hour. Output can be defined as man-hours of surveillance or guarding, adjusted for quality changes (such as introduction of new technologies).

Another part of the output, with a different type of price mechanism, is private investigation services. This is expected to be limited in size. Outputs will be diverse, so that few standard services exist.

Data availability

Output price indices of security services have been developed in many EU member states.

A, B and C methods

The A method would be to collect actual contract prices. The services supplied under these contracts have to be closely monitored in order to control for quality changes if necessary. Close contact with the enterprises that supply the data is desirable. The use of model prices would also be an A method under the usual conditions.

For those services that are carried out on a fee-per-hour basis, charge-out rates or hourly fees could be used to form a B method.

Useful volume indicators for security services could be man-hours of surveillance or guarding and number of cases or clients served by private investigators. If sufficiently appropriate, these volume indicators can be B methods.

4.14.5 CPA 81 - Services to buildings and landscape

This includes facilities support services, cleaning services and landscape services.

Key aspects

These services are quite similar to the previous CPA as far as market mechanisms are concerned: in most cases cleaning enterprises will have medium to long term contracts with the companies they work for. Some services are also consumed by households such as window cleaning and chimney cleaning.

Data availability

These are often standard services for which standard prices could be collected. Producer price indices of cleaning services have been developed in many EU member states.

A, B and C methods

For household services such as window cleaning and chimney cleaning, consumer price information could be used, as an A method for household consumption, and a B method for intermediate consumption.

For cleaning services, office areas (in m²) cleaned or similar indicators could be used. If these are not available, it can be assumed that the amount of cleaning work to be done is proportional to the total office area, or similar assumptions.

4.14.6 CPA 82 - Office administration, office support, and other business support services

Key aspects

This covers a range of services including office administration services, call centre services, convention and trade show organisation and packaging services.

Data availability

There will be a mix of standard type services, for which prices in principle can be collected and services of unique nature.

A, B and C methods

The A method would be to collect actual contract prices. The use of model prices would also be an A method under the usual conditions.

For those services that are carried out on a fee-per-hour basis, charge-out rates or hourly fees could be used to form a B method.

4.15 CPA O - Public administration and defence services; compulsory social security services

Key aspects

Section O of CPA consists mainly of non-market services. They are subdivided into

- 84.1: administration services of the State and the economic and social policy of the community (e.g. general public services)
- 84.2: provision of services to the community as a whole (e.g. defence, justice, police, fire brigade)
- 84.3: compulsory social security services.

While direct output measurement for individual services is preferable, appropriate input methods are classified as B methods. For collective services, due to the difficulty of defining what the output is, input methods are classified as B methods.

In this section, some examples will be given of possible output indicators that can be used for certain types of services. These should be interpreted as starting points: more research is needed to improve on them and to extend them to other services.

In general, the approach to be followed for a particular product is to determine the universe of producing government units (ministries, institutions, agencies, local authorities, etc.). For a representative sample of producers, one or several outputs should be defined in co-operation with those producers. The changes in these outputs should then be weighted by the sum of the costs of each producer (preferably also the unit costs of each output, but such data may be hard to obtain).

- Output for compulsory social security services could for example be measured by the number of people that receive benefits or allowances.
- Output of tax authorities could be measured by the number of tax assessments completed, preferably broken down by type of tax and between routine assessments and investigations.
- Output of patent offices could be measured by the number of patent applications dealt with;
- Output of law courts could be measured by the number of court cases completed, preferably broken down by type of case.
- Output of prisons could be measured by the number of prisoner-days.
- Output of audit offices could be measured by the number of audits or investigations completed.

For many other units or activities, such as the activities of ministries, defence, police, etc., the output definitions are not easy to find.

Data availability

Data on government expenditure are normally readily available. Data on the numbers of persons receiving benefits from compulsory social security and the other examples of indicators given above will usually also be available. Data on the costs of each producing unit is also required to be able to weight the various outputs.

Indicators for the output or even activity of the other services are scarce. However, due to the ever-increasing interest of the general public in the efficiency and effectiveness of the government, it can be expected that more effort will be made to measure output and efficiency within the public sector, and this may lead to the identification of acceptable output indicators.

A, B and C methods

For individual services, output indicator methods are A methods provided they satisfy the criteria given in paragraph 3.1.2.4. If the criteria are not fully satisfied, for example if the level of detail could be improved, the method becomes a B method. If a volume indicator method does not really measure output but rather input or outcome, and/or if the coverage of the output is not representative, this method is a C method. Activity indicators are C methods for individual services, but can be B methods for collective services.

ESA2010 paragraph 10.30 states that quality adjustment of output methods should not be used:

In the European Union, given the conceptual difficulties and the absence of consensus on output methods adjusted for quality (based on outcome), such methods are excluded from the central framework in order to preserve the comparability of the results. Such methods are reserved on an optional basis for supplementary tables, while continuing research.

For individual and collective services, input methods are B methods (see paragraph 3.1.2.4). When input methods are used, they should estimate the volume of each input separately, taking quality changes of the inputs into account. For each category of inputs (intermediate consumption, other taxes and subsidies on production, compensation of employees, and consumption of fixed capital) recommendations on measurement methods are given in the appropriate paragraphs of this handbook. Applying productivity or quality adjustments to the sum of the volume of inputs is not recommended. Such adjustments contribute neither to the quality of the results nor to their comparability.

4.16 CPA P - Education services

Key aspects

The education classification category contains a wide diversity of types of institutional units (schools, universities, further education colleges, vocational institutes, private driving schools, etc.), across a number of sectors (various levels of government, non-profit institutions and non-financial corporations), and can be delivered as a market or a non-market output. Two key features common to almost all education services are:

- Education is an “individual” service, delivered to pupils by educational establishments, which themselves use the inputs of staff time, capital consumption, and intermediate consumption. This chapter does not consider the ‘policy-making’ function in provision of education; this is covered with other collective services in chapter 3.
- Teaching is generally undertaken in groups, which can range from very small groups with close coaching to large seminar or lecture groups of over 100 pupils. But the output measure should focus on individual benefit for pupils and not be based on the group level.

Education output can be defined as follows:

Education output is the amount of teaching received by the students for each type of education.

The quantity of teaching received by students can be measured by the number of hours they spent at being taught. This measure is referred to as the number of "student-hours" (or "pupil-hours"). Where this measure is not available, the simple number of students or pupils can be an alternative, provided that the hours of tuition that an average student receives remain broadly stable over time. For some levels of education (for example tertiary education and distance-learning) the number of students may in fact be a better indicator of the education service delivered, since formally taught hours may comprise a variable and even small part of the education service (which may be more in the form of written material or informal teaching).

It is important that any output indicator chosen is composed of cost-weighted data at the level of education delivered and the method of delivery (for example, part-time or home-study courses should be considered separately). At a minimum the data must be broken down into the internationally-accepted broad levels of education (see A, B and C methods section below for more details). This is because the cost per pupil is known to vary significantly between, and even within, these levels.

Certain education services require a more detailed approach. In the case of higher education, there can be a large variation in the complexity (and therefore cost) of particular courses. For example, medical training is much more resource-intensive than an arts course. Therefore, higher education student numbers should be stratified by type of course, to reflect the different education products which are being offered.

In the case of vocational training (including apprenticeships) the education output to be measured is that for teaching, not 'on the job' training. So if an apprentice receives 10 hours per week of teaching at a college, and works productively for 20 hours under the supervision of a work colleague, the 10 hours is measured as education output whilst the 20 hours is an input to the production process.

Where education is delivered as a non-market output, the current price value of output is determined by reference to the inputs (compensation of employees, intermediate consumption). However the measurement of volume output should not be calculated by simply deflating inputs.

For the purposes of comparability, it is important that any non-education services provided alongside educational services (for example school meals, transport and research in universities) are separately identified and deflated using appropriate price indices where these are available, or using the methods described in other chapters of this handbook.

Data availability

Data availability reflects to a great extent the different educational systems in Member States. Some Member States rely more heavily on private funding and provision than others (though in all Member States, public money is the main source of financing for education). Some Member States have quite sophisticated schools inspection and performance measurement systems, whilst in others this is minimal. In some Member States the education system is heavily centralised, whereas in others it is devolved to regional or local authorities.

Nevertheless, one can generalise. There are abundant data on student numbers (at least at the start of the academic year) and graduates from universities and colleges, together with the number of teaching staff and their salaries. Where there is market provision of education services, the fees charged can be observed over time. Whilst overall cost data are usually readily available for non-market education provision (from public finance systems), there is usually a problem with identifying the average cost for each level of education because of the structure of public finance systems.

There are a number of international programmes to collect and disseminate comparative statistics on education. The OECD collects a number of key indicators from its members (see the latest annual “Education at a glance” publication for an overview) and maintains an education database. UNESCO operates a system for “World Education Indicators” and also promotes an international classification for levels of education (known as “ISCED”). Eurostat also collects and publishes data on education for European countries – see the “Key Data on Education in Europe” publication for further details.

A, B and C methods

The methods discussed below are rather general in nature. The choice of methods must be based on a rigorous statistical and expert analysis of the alternatives available and any A or B method should satisfy the following general criteria:

Non-market services

- a) Complete or near-complete coverage;
- b) Stratification at least to CPA 2008 section P class level

Stratification
Pre-primary education
85.10 Pre-primary education
Primary education
85.20 Primary education
Secondary education
85.31 - General secondary education
85.32 - Technical and vocational secondary education, because the costs for these types of education are different.
Higher education
85.41 - Post-secondary non-tertiary education
85.42 - Tertiary education
Other education (85.5)⁸
Educational support services
85.60 Educational support services

c) Stratification for tertiary education: Tertiary education (CPA 2008 P85.42) should be stratified in line with annex 4 of the International Standard Classification of Education (ISCED) 2011⁹:

0. General programmes
 1. Education
 2. Humanities and Arts
 3. Social sciences, business and law
 4. Science
 5. Engineering, manufacturing and construction
 6. Agriculture
 7. Health and welfare
 8. Services
 9. Other

The ISCED is agreed at UN level and adopted formally by the General Conference of UNESCO Member States. It is also implemented in EU Member States and referenced to in EU legislation for statistics on education and training.¹⁰ The ISCED Fields of Education and Training (ISCED-F) will be revised¹¹ with implementation in the EU planned in 2016.

⁸ A breakdown of "other education" is not necessary as these groupings will be of minimal importance.

⁹ The ISCED 2011 is available at <http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf>

¹⁰ See COMMISSION REGULATION (EU) No 912/2013 of 23 September 2013 on "implementing Regulation (EC) No 452/2008 of the European Parliament and of the Council concerning the production and development of statistics on education and lifelong learning, as regards statistics on education and training systems".

¹¹ For details see <http://www.uis.unesco.org/Education/Documents/isced-37c-fos-review-222729e.pdf>.

At that moment the stratification used for the volume measurement of tertiary education needs to be adapted accordingly.

Since prices are not available, the A method for non-market output is to use “pupil hours”, with the stratification breakdown as above.

Use of numbers of pupils as a proxy for pupil hours is acceptable for these methods if it can be shown that the amount of hours that pupils spent in being taught is sufficiently stable. It is encouraged for tertiary education and distance-learning.

Input methods for an individual service in education are C methods. In addition, any method which does not use at least the minimum stratification breakdown, or which has incomplete or near incomplete coverage of the sector, is a C method. Use of numbers of teacher hours would also be a C method. Any method adjusting the output measures for non-market services by a direct quality adjustment is excluded from the central framework and should therefore be excluded from Transmission Programme data submitted to Eurostat.. If information about output indicators and unit cost are available in sufficient detail, quality can be captured indirectly by stratification.

For education support activities (85.60) which cannot be individualised (eg education testing services), an input method is acceptable as a B method.

In line with the above stratification, the table below gives an acceptable set of output indicators for education.

Stratification	Method/quantity indicator
Pre-primary education	
85.10 Pre-primary education	Number of pupil-hours
Primary education	
85.20 Primary education	Number of pupil-hours
Secondary education	
P85.31 - General secondary education	Number of pupil-hours
P85.32 - Technical and vocational secondary education, because the costs for these types of education are different.	Number of pupils
Higher education	
P85.41 - Post-secondary non-tertiary education	Number of students
P85.42 - Tertiary education	Number of students
Other education	Number of students
Educational support services	
85.60 Educational support services	Input methods can be used

Market Services - An A method is deflating output by suitable PPIs for each type of education service. The price indices should take account of the quality of the service provided (drawing on the possible methods described above), and a check made to ensure that basic prices are used (i.e. including any subsidies on products).

A possible B method is to use appropriate CPIs, corrected to valuation in basic prices and reflecting the quality of the service provided. In the EU HICP, the “price” observed is that for ‘education services’, if it is possible to separate this from educational materials and support (see Council Regulation 2166/99), net of any reimbursements from the state.

If these methods are not available for market services, it is also acceptable to use the A and B output indicator methods described below for non-market services. Any input-based method would be considered a C method.

4.17 CPA Q - Human health and social work services

Key aspects

This CPA section covers individual health and social work services. Their provision can be organised in many different ways: the services can be delivered as market or non-market output; providers include government, non-profit institutions and non-financial corporations; services may be funded through payments by patients (with or without reimbursement by third parties) or through direct financing by government or corporations.

ESA 2010 requires that the minimum level of detail needed to measure non-market production of health services volume growth through output measures is the class level of CPA 2008, as set out below.

- 86 Human health services
 - 86.1 Hospital services
 - 86.10 Hospital services
 - 86.2 Medical and dental practice services
 - 86.21 General medical practice services
 - 86.22 Specialist medical practice services
 - 86.23 Dental practice services
 - 86.9 Other human health services
 - 86.90 Other human health services
- 87 Residential care activities
 - 87.1 Residential nursing care activities
 - 87.2 Residential care activities for mental health etc.
 - 87.3 Residential care activities for the elderly and disabled
 - 87.9 Other residential care activities
- 88 Social work activities without accommodation
 - 88.1 Social work activities without accommodation for the elderly and disabled
 - 88.9 Other social work activities without accommodation

ESA 2010 paragraph 10.30 sets out the case for adopting output methods for non-market health services. However, the implementation of output methods may not be easy, and significant investigations by statistical offices are required. Health output constitutes a significant share of GDP, and so it is important to improve the methods for the measurement of its volume.

ESA 2010 paragraph 10.30 recognises that data availability is a challenge in this area, and says

“Although the use of input-based methods is generally to be avoided, it is possible, in the field of health, to apply the input method when the variety of the services is such that it is practically impossible to determine homogeneous products.”

The recommendations in this section are based on the following definition of health output:

“Health output is the quantity of health care received by patients, for each type of health care. The quantities should be weighted together using data on the costs or prices of the health care provided. The quantity of health care received by patients should be measured in terms of complete treatments.”

For volume measurement the focus is on outputs.

Using a complete treatment as the measurement unit requires account to be taken of the whole bundle of complementary services constituting a treatment: medical services, paramedical services, laboratory and radiological services and, in the case of hospitalisation, non-medical services such as the provision of food and accommodation. In practice, the feasibility of measuring complete treatments is dependent a lot on the

degree of fragmentation of the services making up a treatment (i.e. to what extent the various medical acts which constitute a treatment are supplied by different providers). It is due to data availability and hence a practical compromise that the recommendations in the handbook are based on a narrow concept of treatment which aims at capturing full treatments only within each CPA class.

A specific aspect of the concept of a complete treatment is the re-admission problem. If a patient has to go back to hospital because of the same illness this means that the original treatment has not yet been completed. A second treatment for the same person is only recorded if the patient is sent back to hospital to be treated for a different disease. A kind of re-admission problem also exists for medical and dental practice services. A patient who is treated by a specialist for a specific disease will often need several consultations. Ideally, all visits (first visit + continuation visits) related to the same diagnosis should be counted as one treatment. Later in this section, the argument is made that the equation: one visit = one treatment is likely to hold only for general practitioners.

For hospital services, output (= treatments) can be measured on the basis of so-called DRG-type classifications. DRG (Diagnosis Related Groups) systems are used to classify hospital stays into groups that are medically meaningful and as homogeneous as possible with regard to resource use. Each hospital stay is classified in one, and only one, DRG based on medical and administrative information about discharges. DRG systems vary across countries, but they are sufficiently similar. They are always very detailed consisting of several hundreds of diagnosis related groups.

Technological improvements and health research advances make the quality changes in health services an important issue. Improvements cover both changes from the introduction of new treatments and improvements of existing treatments. Whilst classifications like the DRGs can capture changes in the treatment mix – and the more detailed they are the better they can do this – changes in the quality of a single given treatment are very difficult to measure.

Data availability

The implementation of DRG systems for management and funding purposes in many countries is improving the availability of output data for hospitals (above all general and specialised hospitals). Nevertheless, there are still a number of problems relating to the characteristics of the classifications and the handling of changes.

Normally, information on consultations by general practitioners and medical specialists is available. Such data may be lacking, however, in special situations where, for example, general practitioners work under a collective agreement with a health insurance company or the Ministry of Health to care for the health of a certain group of people and remuneration is not linked to the number of consultations.

Experience shows that, while for many health services satisfactory output indicators are available, the data needed to calculate the necessary weights are much more difficult to

obtain. Whether in terms of output values or costs, weights should ideally be based on exhaustive information, or on representative samples. If such an ideal solution is not possible other, less satisfactory options exist, at least in the case of non-market output, such as: indirect cost weights (derived from costs of complementary activities) or even cost weights based on expert judgment. Both are acceptable only if they are well-founded and sensitivity analyses show the stability of the resulting volume measures.

PPIs for market health services are not widely produced so that deflation of output values by such indices is not an option for most of CPA 2008 Q. CPIs, on the other hand, cover health care related market services and are generally available. But they can only be used for deflation if the relevant prices are recorded gross of any subsequent reimbursements. This is not the case for the EU's HICP.

A, B and C methods

For non-market output, the focus of the descriptive text for the categories of CPA 86 – Human health services – is on the identification and use of sufficiently robust output indicators with the associated cost weights for previous years. However, when such indicators and their cost weights are not considered to be measured to an acceptable standard, input methods are to be used.

Health services are continually improved through new scientific developments, reflecting for example new medicines and new surgical techniques. Stratification to homogeneous products cannot in itself capture all of these increases in the volume output of the services, as the product level detail to which meaningful descriptions can be applied does not capture underlying characteristics which determine the cost allocation decisions of the health provider. The classical approach to such fundamental changes in products reflecting a different bundle of desirable characteristics is through linking new products onto old products. This can be achieved in non-market services by using unit costs as a proxy for prices, and by building hedonic models which link product characteristics to previous unit prices. Such methods have usually been applied to marketed products where there are a variety of similar products whose prices and values can be observed in the market place. The application of similar methods for non-market services such as health is much more difficult, and requires detailed historical information from management accounting systems within the health service. Further work on the nature of the information required and the extent of its availability is desirable.

See Annex 1 for a worked example of how stratification can be used to capture quality change.

4.17.1 CPA 86.1 - Hospital services

Market output

Where PPIs are available which meet the criteria set out in paragraph 2.3, deflation of market output of hospitals by these indices is an A method. The use of a CPI is also an A method provided prices are recorded gross of any reimbursements and the index is

adjusted to basic prices (in case there are subsidies on products). If prices are recorded net, the use of a CPI is a C method. The use of less appropriate PPIs qualifies as a B method.

Output indicator methods which are classified as A or B below are also relevant for market output.

Non-market output

Volume estimates have to be calculated on the basis of direct output measures, without adjusting for quality. Such methods are to be applied at a detailed level. As stated earlier in this section, input methods are allowed when the variety of products is such that it is impossible to determine homogenous products.

A distinction is made between the different types of hospital services within CPA 86.11 to take account of the varying complexity of the different classes of services.

a) services to inpatients by general and specialised hospitals

DRGs that cover changes in the treatment mix will fulfil the requirements for a B method.

Methods which use the ICD (International Classification of Diseases) to classify discharges can also be a B method provided the diagnoses are recorded at a very detailed level and appropriate cost weights are used.

Use of crude output indicators like the simple number of discharges is classified as a C method.

b) hospital psychiatric services

Again, detailed DRGs appropriate cost weights are a B method.

A somewhat weaker method, but still to be considered as B, is the number of occupant days (days of hospitalisation) by level of care weighted together using representative cost information. If hospital psychiatric services are organised in such a way that each type of hospital provides only one specific level of care it is possible to take account of the product mix even if no formal nomenclature of care levels is implemented. It is justifiable to have less demanding requirements regarding the details of the product mix than described above for services by general and specialised hospitals because hospital psychiatric services are more homogeneous.

Output methods that do not distinguish levels of care at all are classified as C.

c) hospital rehabilitation services

DRGs taking changes in mix of treatments are a B method.

The same holds if the number of occupant days by level of care is used. If it can be demonstrated that the different rehabilitation services are relatively homogeneous then the simple number of occupant days could be accepted as a B method.

Unadjusted occupant days by level of care meet the requirements of a B method. In situations where there is relative homogeneity of services, the simple number of occupant days may be accepted as a B method.

Introducing a new product in a volume index

As stated in paragraph 4.18.1, health services are continually improved through new scientific developments, reflecting for example new medicines and new surgical techniques. As stratification to homogeneous products cannot in itself capture these increases in the volume output of services, this leaves the question of how to incorporate substantially improved treatments in the index. They cannot simply be added to the existing (related) category, as this violates the assumption of homogeneity and would introduce a bias in the index. They cannot be ignored, as this would mean underestimating production. The solution is to introduce the improved treatment as an entirely new good (or service) into the index. That is, a good that did not exist in the base period. Since there is not a base period cost weight, one needs to be imputed. In the example below, it is suggested to use the cost of the new treatment when it was first introduced as a proxy, as this can be interpreted as the value attached to the new product by the government in its role as customer.

For the sake of simplicity, in the example below two treatments A and B are distinguished in period T. In period T+1, a new (substantially improved) treatment C is introduced for patients who previously received treatment A. C is a new surgical technique that, while being much more expensive than A, offers much better prospects of improved health than A.

So, how should we compile the volume index?

In option 1, treatment C is considered equivalent to treatment A; the difference in quality is completely ignored. The much higher cost of treatment C is completely reflected in the price index; the volume index remains unchanged. This approach underestimates the “true” volume change of the production of health services.

In option 2, treatment C is considered a new product. Using the introduction “price” of the new product at T+1 as a proxy of the base period cost weight, the substantial improvement is reflected in the volume index. While option 2 is dependent on the assumption that using the cost of treatment B when it was first introduced as a proxy for the base period costs weight, it is preferable to simply combining the treatment with another non-homogeneous product. This approach is broadly in line with the principles set out for incorporating new products in the Producer Price Index Manual (IMF 2004) chapter 21. The assumption behind option 2 can be restated as follows: We assume there is a competitive market, and to win new customers, the product on introduction

will be priced so that the perceived quality improvement is matched by the market price, and so the change reflects volume and not simply price inflation.

	Base year T	T+1	T+2
No. of treatments A	20	18	10
Costs per treatment A	125	125	125
Total costs of treatment A	2500	2250	1250
No. of treatments B	10	10	10
Costs per treatment B	200	200	200
Total costs of treatment B	2000	2000	2000
No. of treatments C	0	2	10
Costs per treatment C		500	400
Total costs of treatment C	0	1000	4000
Total costs	4500	5250	7250
Index of total costs (T=100)	100	116.7	161.1
<u>Option 1</u>			
<i>C is considered equivalent to treatment A; the difference in quality is completely ignored.</i>			
No. of treatments A (and C)	20	20	20
Costs per treatment A (and C)	125	162.5	262.5
Total costs per treatment A (and C)	2500	3250	5250
No. of treatments B	10	10	10
Costs per treatment B	200	200	200
Total costs of treatment B	2000	2000	2000
Volume index (T=100)	100	100	100
Value index (T=100)	100	116.7	161.1
Price index (T=100)	100	116.7	161.1
<u>Option 2</u>			
<i>C is considered a new product; in order to introduce it in the volume index, we need to impute a "price" for base period T; here, we use the costs per treatment in the introduction period T+1 as a proxy.</i>			
No. of treatments A	20	18	10
Costs per treatment A	125	125	125
No. of treatments B	10	10	10
Costs per treatment B	200	200	200
No. of treatments C	0	2	10
Costs per treatment C	500*	500	400
Volume index (T=100)	100	116.7	183.3
Value index (T=100)	100	116.7	161.1
Price index (T=100)	100	100	87.9
	* imputation		

4.17.2 CPA 86.2 - Medical and dental practice services

Market output

The use of PPIs is an A method although, in practice, these are unlikely to be available. The use of a CPI is also an A method provided prices are recorded gross of any reimbursements. CPIs which record prices net of reimbursements are a C method. All non-market output methods classified as A or B below are also appropriate.

Non-market output

The main distinction is between services by general medical practitioners on the one hand and services by specialists on the other, the former being less complex.

a) CPA 86.21 services by general practitioners.

The services of GPs are such that each visit can be considered as constituting one treatment. Consequently, the recommended A method is the number of consultations by type of treatment, It might be difficult, however, to obtain the corresponding cost weights. In the case of proxy weights or only partial quality adjustment the number of consultations by treatment is a B method. The simple number of consultations can also be accepted as a B method if the different types of treatment are sufficiently homogeneous with regard to the resource requirements (similar cost weights).

b) CPA 86.22 services by medical specialists

On the assumption that treatments by specialists are normally such that a first visit is followed by follow-up visits it is justifiable to take the number of first visits as an indicator of complete treatments. Admittedly, this hypothesis requires further testing. If it proves valid, the number of first visits broken down by type of specialist and type of treatment, weighted with appropriate cost weights, is the B method. If a distinction by type of treatment cannot be made, the number of first visits is not the appropriate indicator. Under these conditions (as in the case of dental practice services) the total number of visits is considered to be a B method. The distinction between specialists is indispensable for a B method.

c) CPA 86.23 - Dental practice services

Most dental services are market services. An A method is the use of the CPI adjusted to basic prices and quality changes. Prices must be recorded gross of any reimbursements and the CPI must be calculated at a sufficient level of detail. If prices are recorded net of reimbursements the use of a CPI is a C method. An output indicator method which meets the requirements of a B method is the number of treatments by type of treatment. As in the case of medical specialists the number of first visits can be assumed to indicate the number of complete treatments.

If a distinction by type of treatment cannot be made it is not meaningful to count only first visits. Under these conditions the total number of consultations (visits), seems to be the better indicator because then the types of treatment which consist of a higher

number of visits and are assumed to be more resource-intensive get a higher weight. The total number of visits is considered to be a B method.

4.17.3 CPA 86.9 - Other human health services

Where these services are provided as market services, the use of the appropriate component of the CPI is the recommended approach. If an adjustment is made to basic prices this is an A method, if not a B method.

Non-market output

This category includes the activities of nurses, midwives, physiotherapists or other paramedical practitioners in the field of optometry, hydrotherapy, medical massage, occupational therapy, etc.

The DRG system does not cover nursing services. In view of the limited degree of diversity of these services, occupant days by level of care are an A method. Different care levels can be captured directly by systematically applying classifications or indirectly by grouping institutions that provide the same level of care.

Input methods are considered a B method for this category.

4.17.4 CPA 87 - Residential care services

These services include welfare services delivered through residential institutions to old persons, handicapped persons, children and young people. They do not include a medical service component provided by doctors. If lodging is combined with medical services under the direction of a doctor CPA 86.1 (hospital services) is the relevant CPA item. The borderline between the two, however, may sometimes be blurred.

For market output deflation by the appropriate component of the CPI (adjusted to basic prices) is the A method. Occupant days by type of institution will meet the requirements for a B method. This supposes that the services provided within each type of institution are sufficiently homogeneous.

For non-market output, input methods are allowed as a B method. Output volume indicators without quality adjustment would also be considered a B method if those indicators provide good coverage and are sufficiently detailed.

4.17.5 CPA 88 - Social work services without accommodation

To the extent that these services are market services the use of the relevant CPI component adjusted to basic prices is an A method. Without this valuation adjustment to the CPI a B method is obtained.

For non-market output, input methods are allowed, although use of output volume indicators without quality adjustment would also be considered a B method if those indicators provide good coverage and are sufficiently detailed. The number of persons receiving care by level of care is a B method for non-market output.

4.18 CPA R - Arts, entertainment and recreation services

There are features of some of the services in CPA R that create particular challenges when measuring price and volume changes. Particular methodological issues include the treatment of unique products (e.g. services of performing artists), the bundling of products (e.g. library services), and the provision of a product to a number of consumers at the same time (e.g. a theatre performance). Quality is difficult to measure for some services, particularly where individuals' personal enjoyment is a determining factor. There are also practical issues, especially dealing with the large number of small providers for some services, and distinguishing between business and household consumption.

In line with the recommendations given in other areas of the handbook, any methods for the market products in CPA R which are based on inputs rather than outputs would be considered C methods.

4.18.1 CPA 90 – Creative, arts and entertainment services

It is useful to deal with those services provided to an audience of consumers for the purposes of entertainment (for example showing films and plays) separately from the services provided to individuals or businesses (for example film processing and betting services).

Services provided to an audience

Key aspects

This sub-group includes motion picture projection in cinemas, presentation of theatrical or musical productions in theatres, fairs and circuses, museums and zoological gardens, and sports events. The common feature is that an entertainment service is provided to a group of spectators. The output of the service is the presentation of the 'performance' to the spectators. The outcome of the service is the personal enjoyment and education given to the audience by the performance. As with provision of transport services (see section 4.6), the key principle here is that output should ideally be linked to the number of tickets sold for access to the service, specified by the various types of tickets (so that purchase of a "season ticket" implies a different service than a one-off ticket).

Quality is an important factor here – different forms of entertainment may be perceived as different products or of different qualities. Similarly, some seats in desirable locations within the auditorium or for particular performances are sold for higher prices – this represents a different quality of service which should be reflected in the volume measure. And certain performances may be perceived as of a different quality because of their timing (for example matinees are often cheaper than evening performances)

The availability and quality points above imply that methods using the number of tickets sold as an indicator of output should be undertaken at a high level of detail, distinguishing season tickets from single-use tickets, the location of seats, and the different types of entertainment productions.

One point to watch is the availability of discount prices for large groups, or cheaper promotional prices, which should be fully reflected in the price measures. There may also be a significant subsidy system in operation for some services – for example a museum that grants entry for free (where the basic price is in effect the subsidy per entrant because the subsidies are treated as subsidies on products – see ESA 2010 para 4.35c). In this case, the number of entrances is an important indicator for the volume of services provided.

Data availability

Service providers will often collect the attendance at cinemas, theatres, circuses and sports events by type of ticket, so this should be available for collection. However, the availability of the data to the statistical office may be determined by the concentration of the industry – for example, if the cinema industry is dominated by a few large firms, ticket data can be expected to be reasonably accessible. But a large number of service providers in some classes of service can mean that data collection is not always straightforward. Administrative records may be available from the Culture Ministry, or Trade Associations (e.g. a theatre association) may collect data from their members. Within Europe the annual ‘AUVIS’ (audio-visual) questionnaire collects data on cinema admissions and average ticket prices.

It is very likely that the price data for the major audience services will be collected for the CPI. In the EU, the HICP specifically requires collection of data on cultural services such as cinemas, theatres and museums. Therefore these data should be readily available.

A, B and C methods

The A method here for services provided purely to households is to use detailed CPI series adjusted to basic prices as deflators for the value of tickets sold. The method would need to take account of discounted tickets, and any other features that will have a significant influence on quality (for example free programmes or telephone booking).

The B methods here are to use the CPI for services which are also provided to businesses (providing that it can be shown that this is a reasonable assumption), or to use the number of tickets sold broken down by type of seat and performance as a volume measure. In the event of ticket data being unavailable, the number of performances could be used as a measure, though this is barely a B method.

Any methods which use a CPI to inappropriately deflate business purchase, which use an insufficient breakdown of product detail, or which use input-based data, are considered C methods.

4.18.2 CPA 91 - Library, archive, museum and other cultural services

Key aspects

A library may have a number of outputs – primarily the lending of books and other materials, but also making available reference material, and providing a location within

which to read books, newspapers and periodicals. Government typically provides libraries as non-market services, although individual libraries may also provide market services for payment (such as the renting of videos) which can be measured in the same way as other market services.

The key decision to make here is whether to adopt the number of books and other products lent as a volume indicator for the whole of library output, or to include an indicator for visits to the library alongside lending. Ideally one would use both sets of information, but data on visits are not always available. Alongside this, one should take account of changes in quality (for example increases in the stock of books or an expanded reference section).

Data availability

Data on items lent may be available from library records where these are kept electronically, broken down into the major types of items (books, music etc). Data on visits may be available from physical counts by library staff or from surveys of library members. In some cases government uses these data for funding and other decision-making purposes.

A, B and C methods

The A method for libraries is to combine output data on lending (broken down by major item type) with data on visits, adjusted for quality factors such as the range of reference material available. This combination is best achieved using a cost-weighted approach. Any market services provided need to be measured by value of sales deflated by an appropriate price index.

The B method for libraries is to use data on lending (broken down by major item type) as an indicator of the overall output of the library.

4.18.3 CPA 92 - Gambling and betting services

Key aspects

Gambling and betting services provide entertainment to gamblers by allowing them the chance for making future gains in wealth. There is some analogy with non-life insurance services, in the sense that the insurance company is offering a service for pooling risk, although the gambling firm's financial reserves are held purely for the operation of the firm rather than for individual consumers and the total size of the bets is usually determined by the gambler, not the betting firm.

There are a number of different types of gambling and betting service, and it is important to distinguish between them for practical purposes (even if the underlying philosophy is the same):

- Lotteries (state and private)
- Casinos

- Betting services (phone, internet, shops)
- Gaming machines

The means of measuring the activities of lotteries and gambling at current prices is set out in paragraph 4.135 of ESA 2010. The amounts paid in are split into two elements - the service charge levied by the operator and the amount transferred to successful gamblers.

Ideally, the service charge of the gambling service would be directly measurable. This may be true for some heavily regulated areas of the gambling industry, such as state-run lotteries. If the information is readily available, and adjustments can be made for quality changes (for example, faster payouts or type of game), then this does not pose a particular problem for price and volume measurement.

In the absence of detailed information on service charges, the total number of bets made by gamblers would be the most appropriate quantity indicator to use. This would not of course reflect changes in the average amount wagered per gambler or per bet, but it is questionable whether the overall size of the bet corresponds with the entertainment service provided to the gambler.

It is also important to consider quality of the service. The outlet is obviously an important determiner of quality because it determines the “personal” nature of the service received and the accompanying benefits to the gambler. For example a betting service can be provided through a shop, over the telephone, at a sports event, or over the internet. In the latter case, development of computer and direct payment technology has allowed substantial productivity improvements to be made. Each of these outlets can be considered a separate quality of service, and therefore the data should be broken down by type of outlet wherever possible. The volume changes of each outlet can then be weighted by total turnover in the base period.

The design of the game may also have an impact on entertainment quality. It is also possible that the odds of winning could be viewed as a quality, though (given the usual organisation of the industry) summing the odds of winning across all gamblers would largely offset changes in the number of bets, since (other things remaining equal) a greater number of bets would reduce the overall chances of winning.

The following example illustrates the calculation of volume of betting services:

	Number of bets	Total amount bet	Number of payouts	Total payout	Output of service
Year T-1	100	1000	10	800	200
Year T	120	1400	20	1100	300

Overall value of output has increased by 50% between the two years. The number of bets made has risen by 20%, and this gives the change in the volume of the service.

In the case of casinos, it may be more straightforward to treat the entire casino as an entertainment service (since the casino will probably offer a wide range of services other than pure gaming) and, by analogy with a public performance of a film (see section 0), to use the number of persons entering the casino as the measure of the volume of the service.

Finally, there is a timing point to consider. Some bets may be made well in advance of expected payout (for example a bet at the start of the football season on the expected winner at the end). If the balance of bets changes year on year, this may introduce a discontinuity into the volume series. However it may be assumed that the majority of bets made will be paid out in the same accounting period.

Data availability

Betting and gaming firms can be expected to have information readily available on the number of bets made.

Data from casinos on individual bets and payments is probably impossible to gather, and the most likely measures available (as discussed above) will be number of persons entering the casino. This is unlikely to be difficult to collect from casinos.

A, B and C methods

The A method for gambling and betting services is to directly deflate service charge data by a price index of these services, with adjustments for quality changes as appropriate. This is only really suitable for a state-run lottery, or other heavily regulated service, where direct data on service charges are available.

The B method for betting is to use the number of bets made as a volume indicator. Each type of betting outlet (telephone, internet, shops) should be distinguished and (ideally) different types of games should also be distinguished, with weighting provided by the proportion of total amount bet in the base period. The B method for casinos is to use data on the number of persons entering.

4.18.4 CPA 93 - Sporting services and amusement and recreation services

The same principles that are applied to CPA90 under 4.16.1.1 apply to this heading.

Sports facilities

Key aspects

The output of sports facilities (whether specific facilities, leisure centres or through sports associations) is best measured by the number of tickets purchased for access to the facilities. Ideally a visit which takes advantage of several, separately charged, services (e.g. swimming and gym at a leisure centre) would count as a higher volume of output than a visit using a single service. Where a season ticket system is in operation, allowing multiple entries on a single ticket, this should count as a separate product. If possible, the quality of the facilities provided should also be taken into account.

Data availability

CPIs will generally record a range of sports services to the public and is therefore a good source of data.

Data on tickets sold broken down by type should be readily available from leisure centres and other sports facilities.

A, B and C methods

The A methods here are to use detailed CPI data, adjusted to basic prices, or to use the number of tickets sold broken down by type of ticket and, if possible, activities undertaken. Some adjustment should be made for quality of the facilities, and paying spectators should be measured separately from participants.

The B method is to use tickets sold which are not broken down sufficiently to reflect the different types of services, or which use detailed CPI data which is not fully representative of the activities.

4.19 CPA S – Other services

This product division covers services furnished by membership organisations; repair services of computers and personal and household goods; and other personal services. The major services included within this section are discussed below.

4.19.1 CPA 94 - Services furnished by membership organisations n.e.c.*Key aspects*

This product division consists almost entirely of non-market services, provided by Non Profit Institutions (NPIs) such as professional bodies, trade unions, and religious organisations. The common feature is that payment of a membership fee covers a range of services, which may or may not be used by the individual member in a particular time period.

Data availability

The large number of small units providing some of these services, and the exemptions often granted to them by Government (e.g. for taxation purposes), mean that there can be a shortage of suitable data in this area. Nevertheless the organisations can be expected to maintain reasonably comprehensive and up-to-date membership registers, identifying different types of membership (e.g. full member, part member, non-voting member etc), and there is sometimes a mandatory provision of information at least once a year to the Government administration responsible for monitoring NPIs (including a set of accounts where monetary flows are significant).

A, B and C methods

The only suitable A method here is to obtain detailed information on the provision of services actually provided to members, broken down into a fine detail and weighted by the costs of provision. For example, a professional organisation providing legal advice,

conferences, and examination and accreditation services to members would provide data on each of these activities, or a religious organisation would provide data on attendance at services or number of services held. Clearly this kind of data collection could impose a substantial burden on these organisations.

The B method is to use number of members as a proxy for output, but the different types of membership must be captured if they give significantly different entitlements to receive services, and it must be clear that the average use of services by members does not change significantly year on year.

4.19.2 CPA 95 - Repair services of computers and personal and household goods

For the output of repair of personal and household goods, CPIs (adjusted to reflect basic prices) can be used. As there will be little business expenditure on these services, a CPI will be quite appropriate, and might be regarded as an A method. However, various CPI headings will have to be used as various different products are included here. Therefore, deflation is necessary on a detailed level in order to be able to apply the various detailed CPI headings involved.

4.19.3 CPA 96 - Other personal services

CPA 96.01 - Washing and dry cleaning services of textiles and fur products

These services are provided to both businesses and households. For households, CPI data could be available on these services (costs for using a laundromat, and for the dry cleaning of standard items). For business services, there is often a contractual relationship and suitable volume indicators may be number of kg of material washed or number of standard 'loads'. Use of the CPI and volume data are both considered B methods.

CPA 96.02 - Hairdressing and other beauty treatment services

This product is almost entirely provided to households and is captured by the CPI. The best method is to use a "model price", where the model is a standard representative product such as a shampoo and cut. Use of CPI data represents an A method if an adjustment is made to basic prices.

CPA 96.03 - Funeral and related services

This product is entirely provided to households and is captured by the CPI. There are standard products available in the industry, so pricing is straightforward, and use of CPI data represents an A method if adjusted to basic prices.

CPA 96.04 - Physical well-being services and CPA 96.09 - Other personal services

These cover a variety of services, most of which are delivered as standard products (e.g. pet care services, dating agencies, astrologists, prostitutes), which can be priced in different time periods and a price index constructed. Use of these standard products would be an A method if all quality effects were taken into account, and a B method otherwise.

4.20 CPA T - Services of households as employers of domestic personnel

Key aspects

This product category covers those services provided to households by paid staff who are not themselves classified as independent units of production (the production of such units is classified elsewhere within the CPA). Examples include cleaning ladies, nannies, butlers and gardeners. By convention the national accounts production boundary excludes unpaid services produced by householders themselves for their own consumption. The valuation of output is defined in par. 3.87 of ESA 2010 as equivalent to the compensation of employees paid, including any income in kind.

Data availability

Data are likely to be available from tax administration records and labour force surveys for this category of staff relating to both the number of staff and their earnings (including income in kind), and some CPI data are collected for the prices of domestic services. Charge-out rates may be available for some categories of staff.

A, B and C methods

Whilst the best theoretical method to measure volume of output of these services would be to collect data on the activities of staff (for example number of rooms cleaned, number of hours of childminding), this is very unlikely to be feasible in practice.

There are three other possible B methods for estimating output at previous year's prices:

- use of CPI data adjusted to basic prices,
- use of wages or charge-out rate data and,
- volume extrapolation using the number of staff as the extrapolator.

The first two methods should take into account income in kind. Given the possibly incomplete coverage of the CPI in this area, and the problems of adjusting wages and staff numbers for productivity changes, the three methods described are all B methods.

Any CPI or wages data method which does not take into account income in kind should be considered a C method.

5. Application to Quarterly accounts

5.1 Introduction

The preceding chapters in this handbook have been primarily concerned with discussing the methods available for constructing chained volume national accounts on an annual basis. However the evolution of the quarterly GDP, and its components, at previous year's prices is an extremely important short-term economic indicator. The compilation of quarterly accounts at previous year's prices raises a number of methodological and practical issues, which will be examined in this chapter.

The ESA 2010 covers quarterly accounts only briefly in chapter 12, but was supplemented by a detailed Eurostat Handbook on Quarterly National Accounts.¹² Also relevant are the IMF "Quarterly National Accounts manual"¹³ and the OECD "Compilation Manual for an Index of Services"¹⁴. It is not the intention of this chapter to duplicate the discussion in these manuals, and cross-references are made where appropriate.

5.2 Data availability

The most common problem encountered when compiling quarterly national accounts is that some data sources (such as the annual industry enquiry or company accounts) are only available on an annual basis. However some others are routinely available quarterly or even monthly (such as price indices). In general there is a necessity to use less complete data sources – in terms of coverage, detail, or classification. Chapter 4 in the Eurostat quarterly handbook explains the options available for estimating quarterly data when basic data is not available. Compilation of quarterly accounts at previous year's prices increases the data requirements, and therefore adds to the difficulties found for compilation at current prices.

ESA2010 makes it clear that quarterly accounts should "adopt the same principles, definitions and structure as the annual accounts." (par. 12.03). Given that the A/B/C classification used in this handbook is based on a theoretical assessment of suitability, rather than a practical assessment, it is clear that the same standards applied for the annual accounts should apply equally to the quarterly accounts. This will undoubtedly mean that A methods are less achievable for a quarterly environment and more B methods will be used. But it does not mean that C

¹² Available from the European Publications Office; ISBN 92-828-7259-9

¹³ See <http://www.imf.org/external/pubs/ft/qna/2000/textbook/index.htm>

¹⁴ See http://www.oecd-ilibrary.org/economics/compilation-manual-for-an-index-of-services-production_9789264034440-en

methods are any more acceptable for the quarterly accounts than they are for the annual accounts. A section later in this chapter considers the application of A/B/C standards to the mathematical and statistical (“indirect”) methods commonly used by some countries to estimate their quarterly accounts.

A general difficulty raised when compiling chained volume quarterly accounts is the availability of data to undertake the “double-deflation” methods that are recommended in this handbook for calculation of GDP from the production side (see section 3.4). Usually this is caused by a lack of information on intermediate consumption. The most common methods used in the quarterly area are “single indicator” methods that extrapolate value added by using an output indicator. These methods are discussed below.

Despite the data availability difficulties, there can be considerable advantage in employing a multi-approach method (at least from the production and expenditure approach); chapter 8 of the Eurostat quarterly accounts handbook covers this in some detail. Whilst resource constraints may limit the compilation of a complete set of quarterly Supply and Use Tables at previous year’s prices, even at a less detailed product level, the use of a Supply and Use Table framework provides an opportunity to reconcile different (often incomplete) data sources. Data availability and reliability will determine which method carries greatest weight in the reconciliation. Estimates of production, based on quarterly business surveys, may provide a very comprehensive coverage of many products, though (as mentioned above) intermediate consumption data is usually more difficult to collect, and services may be less well covered. By contrast some expenditure data, for example government and foreign trade data, are more readily available on a quarterly basis, as are consumer and foreign trade price indices. However, the collection of household consumption data, and data for investment (particularly for changes in inventories), is more difficult on a quarterly basis, not least because of the associated accruals problems.

It may well be that, for some industries, quantity indicators are in fact more widely available on a quarterly basis than value or price data. The IMF quarterly manual provides some examples of possible sources in paragraph 3.41, whilst pointing out in the preceding paragraph that use of quantity indicators may be unsuitable under certain circumstances (for example, where products are heterogeneous or where secondary production is significant).

5.3 Specific issues

In addition to practical problems of data availability, there are also some theoretical questions, both in individual subject areas (discussed one by one below) but also at a general level – for example, the choice of chaining method and the treatment of seasonality in the accounts – which are covered in the following sections. Many of the issues are common to both current and chained volume measurement, but measurement in previous year’s prices raises further complications.

5.3.1 Agricultural Output

A general question arises of measuring output on an accruals basis, where a continuous production process spans a number of accounting periods. This is most pronounced for agriculture where, for example, the growing season for crops will span three quarters of the year, with the harvest taking place in the third quarter, and preparation of the fields taking place in the last quarter of the preceding year.

ESA 2010 is clear that production of agricultural output is a continuous process, and therefore production should be allocated to each period, with work-in-progress being recorded at the end of each period. The Eurostat quarterly handbook (paragraphs 2.54 – 2.72) suggests two possible solutions to this issue at current prices – either:

- The recommended method - to distribute forecasts of the value of harvest output in proportion to the input costs in each quarter, or;
- The alternative method - to assume that output in those quarters with no production of finished goods is equivalent to input costs.

When calculating the volume of quarterly agricultural output, the main difficulty is to decide which price index to use. Theoretically the price to be applied should be the price prevailing during the period of production, but in practice the prices prevailing during quarters out of the harvest season might be rather unsuitable. If the recommended method from the Eurostat quarterly handbook is adopted, the forecast of value of output requires a suitable price and quantity forecast for each type of product, where the price relates to the basic price forecast for final harvest output (not the price prevailing during different quarters). It is therefore possible to use the quantity forecasts as a volume indicator (providing that the detail is sufficient to differentiate quality), although revisions will need to be made to the data when the final output data are known. If the alternative method is adopted, and input costs are used as an estimate of output, one should continue to use a forecast of the product price as a deflator, since deflation by a price index for inputs would only generate the volume of inputs.

5.3.2 Seasonal products and product differentiation

There are some products whose price varies significantly over the year, and other products that are only produced and sold at certain times of the year. In the first case, price movements can be measured and applied to the value of flows – this does not present a conceptual difficulty. However in the second case, a difficulty is created if the quantity of a product sold falls to zero in one or more quarters of the year. This is particularly important for agricultural products, where seasonal varieties are commonplace (for example, potatoes) and where both production and consumption tend to be seasonal. A rather different example is business audits, which may take place only annually after the close of the financial year. In other cases, consumption is seasonal but production may occur throughout the year (for example clothing).

The recommended method to deal with this in compilation for volume of GDP is to treat the seasonal products as separate products, using quantity or price information at the greatest possible level of detail. This may mean that products appear during only certain quarters of the year, but if this is a regular event, the chaining methods recommended below can reflect the good in the weighting pattern.

Seasonal products present more of a challenge for compilation of price indices. If a price index such as a CPI is used to deflate value of consumption at a less detailed level of product breakdown, it is important that the national accountant understands the way the price statisticians treat seasonal products for the product groups where they are significant.

5.3.3 Non-market services

Section 3.1.2 of this handbook discusses the issues relating to measurement of non-market output at previous year's prices. The concept of measuring non-market output at current prices does not differ between quarterly and annual accounts – output is estimated as the sum of costs. Given that the largest input for non-market services is labour, one would expect to see a reasonably steady quarterly profile of costs over the year (unless numbers of staff changed substantially during the year for some reason). When viewed on a quarterly volume basis however, the output of some non-market services (as defined earlier in this handbook) is likely to be seasonal – for example education output of schools will be low during the school holidays (as pupils are not being taught), and the health services will generally be more busy during the winter months.

The idea of seasonal patterns of production here is no different from a firm shutting its factory over the summer or Christmas break, but in the case of a factory the (lower) output figures for the period will reflect the holidays. If volume of output is measured as the deflated sum of input costs, and input costs continue to be paid even when production is not taking place, this imputes output when it is not in fact taking place. The same can be said of methods that extrapolate output from the numbers of employees (as described in paras 2.78 to 2.79 of the Eurostat quarterly handbook).

The A/B/C classification applied in sections 3 and 4 should continue to be applied, even if the practical obstacles are greater on a quarterly basis. Input methods are no more acceptable for quarterly estimates than they are for annual estimates.

5.3.4 Inventories

Methods available for the measurement of inventories at previous year's prices are considered in section 3.7 of this handbook. The Eurostat Quarterly National Accounts Handbook¹⁵ discusses inventories in paragraphs 2.136 – 2.161.

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http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-GQ-13-004

5.3.5 Tourism

Many products predominantly consumed by tourists are likely to show significant seasonal variations in prices and volumes over the year. Some products (for example ski holidays) may only be available at certain times of the year, and this generates a 'seasonal products' problem that is discussed above. It may be helpful to examine the data available from tourism satellite accounts (if they are compiled) to gain a feel for the issues involved. There are two main points that need to be considered for products predominantly consumed by tourists:

- Where package holidays are purchased well in advance of actual consumption, this can create a difficulty in determining the appropriate price to deflate the value of output. Whilst booking in advance is of course common in many service industries (such as entertainment and personal services), many people will book their holidays significantly in advance so that the booking falls in a different quarter, or even in a different year. The measurement principle to follow here is that if the same holiday is booked at different times, then in fact it is a different quality of holiday (that is, the price difference must be seen as a volume effect, as for airline tickets). If the CPI is used for deflation purposes here it is instructive to look at the methodology used in the CPI to measure package holiday prices, to ensure that it lines up with the required methodology in the national accounts. Some CPIs may record prices when the holidays are booked, although within the EU Harmonised Index of Consumer Prices (HICP) the requirement is to record the prices for services when the consumption of those services can commence.
- Where a tour operator is not organising a package of tourism products, domestic tourism can be broken down into a number of constituent products – travel products, accommodation products, food and entertainment products, and travel agency services. Whilst one might expect that the seasonality of prices of these products might be similar in some areas, each of these products should be treated separately according to the methods described in chapter 4 of this handbook.

5.4 Use of price data

Price data are widely available on a sub-annual basis – generally monthly for consumer and producer prices. The price movements used in compiling the annual accounts are usually based on the sub-annual data. Definitions of prices are the same for quarterly and annual accounts. These points should ensure consistency between the deflation of annual and quarterly data.

However, one must consider the issue of which price to use for deflating output. For any particular quarter, the national accountant may have monthly data available for each of the three months, together with derived quarterly data (which may or may not be available from the price statisticians themselves). Theoretically, the best price measure to use is one that reflects the pattern of expenditure throughout the period – it cannot be acceptable to use prices that prevail at only one point in the period.

Price statisticians tend to use a fixed set of weights when calculating the monthly evolution during a particular year, and use chaining based around the overlap in a specific month of the year (for example December in the case of the EU's Harmonised Index of Consumer prices) to link the series. The national accountant should understand the compilation and chaining methods used in price indices and ensure that these are appropriate for deflating national accounts data. For example, it may be that the majority of output occurred in one particular month, when prices were lower than in the other two months. Applying a quarterly price index in this case would tend to underestimate output, and it would be more appropriate in the national accounts to weight the monthly price changes by the quantities of products transacted in each month (see section 3.4).

5.5 The classification of indirect methods

Whilst all countries experience substantial gaps in the data available on a quarterly basis, some countries choose to rely heavily on mathematical and statistical models to derive their quarterly accounts from short-term indicators. These methods are described in detail in chapter 5 of the Eurostat quarterly handbook.

Choice of chaining method

The choice of chaining method cannot be seen in isolation from two other key compilation methods (benchmarking and seasonal adjustment), which are discussed later in this chapter.

Within the EU, Commission Decision 715/98 sets out the requirement in the annual accounts for chain linking a series based on weights derived from the previous year (Laspeyres formula). The Decision gives no specific requirement for chain linking in the quarterly accounts, other than they should be as consistent with the annual accounts as possible.

There are three possible methods for constructing quarterly estimates within an annual chain linked system:

- Annual overlap – This uses average price data from the previous year (t-1) as the weighting for each of the quarters in the current year (t), with the linking factors being derived from the annual data.
- Quarterly overlap – This requires the compilation of one quarter (say the fourth quarter of each year) at both the average prices of the current year and the average prices of the previous year, which then provides the linking factor for the current year
- Over the year – This requires the compilation of all quarters at the weighted average prices of both the current year and the previous year, which then allows extrapolation of the reference year level.

The Quarterly National Accounts Handbook discusses the advantages and disadvantages of these three methods and provides worked examples in paragraphs 6.41 – 6.75.

Benchmarking

The process of benchmarking is described in the Eurostat quarterly accounts handbook (chapter 5). The underlying aims are to ensure that the quarterly accounts are consistent with annual accounts, a key requirement of customers, and for data quality improvement. The consistency between annual and quarterly data should apply to both current and chained volume data, where the chained volume data are expressed in prices of the same base year as the annual data.

The starting point for benchmarking is to determine which of the annual or quarterly data can be considered the most reliable. In almost all cases the (well established) annual data will be the most reliable, because it will be available in greater detail and will usually be based on a fuller survey, or even census, source. The comparison of different sources is usually very helpful in testing and improving the quality of estimates. For some data, the annual source might be the same source as the quarterly data.

A major concern when benchmarking is to avoid the introduction of a “step” into the series – this might occur if the first quarter of a year is adjusted, thereby altering the growth rate from the last quarter of the previous year. This problem will tend to occur if a “pro-rata” solution is adopted – that is, simply distributing the difference between the sum of the quarters and the annual total over each of the quarters in proportion to the existing quarterly value.

In order to avoid the step problem, it is necessary to maintain the relationship between the benchmark figure and the indicator series over the period of estimation. There are three approaches for undertaking this:

- Pro-rata adjustment;
- Denton difference method;
- Denton proportional method.

These are discussed in Chapter 5 of the Quarterly National Accounts Handbook.

5.6 Seasonality

Seasonal adjustment of quarterly accounts is discussed in the Eurostat quarterly handbook (chapter 7). For many products, there will be little or no seasonality (other than that introduced by traditional holiday periods) in either price or volume. However, as noted above, there are a number of products for which both price and volume can be markedly seasonal, and this naturally introduces seasonality into the national accounts estimates. It is recommended that both seasonally and non-seasonally adjusted series be derived for chained volume quarterly accounts.

Standard seasonal adjustment techniques are of course equally applicable to both current and chained volume data (the Eurostat quarterly handbook discusses the different models and packages available). Nevertheless for prices and volumes data, there is a choice between seasonally adjusting the value, volume and price

series independently, or seasonally adjusting two series and then deriving the third by imputation.

5.7 Conclusion

This chapter has shown that there are specific conceptual and data availability problems to be addressed when dealing with quarterly prices and volumes data in the national accounts. Nevertheless, the key principle remains that the A/B/C classification described in the remainder of this handbook remains unchanged when applied to a quarterly environment. This will undoubtedly mean that more B, and perhaps even C, methods will need to be employed, but this reflects the practical difficulties with deriving intra-annual data.

Annex 1 – Capturing quality effects through stratification

Consider a box of chocolates which includes a mix of milk and plain chocolates. In the base year, there are thirty chocolates in the box and it costs 7.5 euros to buy a box. Over time, the mix of chocolates changes, there being more plain chocolates than milk chocolates and this pushes up the price of the box. So in a later year, the cost of a box of chocolates is 13.5 euros.

Considering the box as simply a box of mixed chocolates, there has been no change in the quantity of chocolates in the box (thirty) and so the quantity index remains unchanged. The rise in price is accounted for through a rise in price of the chocolates, which was 0.25 euros in the first instance, and this has risen to 0.45 in the later year.

However, if information is available about the price and quantity of the plain and milk chocolates making up the box, we can capture the quality change in the box that reflects the increase in the proportion of the more desirable and enjoyable plain chocolates.

If the mix of the box in the first year is 20 milk and 10 plain chocolates, at a price of 0.125 euros and 0.5 euros respectively, then this accounts for the number of chocolates (thirty) and the overall cost (2.5 euros milk and 5 euros plain, giving a total cost of 7.5 euros). In the later year, we know that in fact there are only 4 milk chocolates in the box and 26 plain chocolates. The price of each type of chocolate has remained the same - milk chocolate 0.125 euros and plain chocolate 0.5 euros.

Now we can measure the change in quantity of the milk and plain chocolates separately, allowing for the different utility of each chocolate type reflected through the price.

So the number of milk chocolates with a base year cost 2.5 euros, changed from 20 to 4. The number of plain chocolates with a base year cost of 5, changed from 10 to 26.

Weighting together the two changes by the relative costs in the base year gives:

$$2.5 * 4/20 + 5 * 26/10 = 10/20 + 130/10 = 0.5 + 1.3 = 1.8 \text{ or } 180 \text{ with a base of } 100.$$

So by stratifying the chocolates by type, where there are significant differences in cost and quantity change, we capture the quality change in the final box reflected in the increased amount of more costly and desirable chocolates, the plain ones.

For this simple case of no price change in each type of chocolate, this can be restated as follows:

the plain ones are 4 times more desirable than the milk ones, as reflected in the price of an individual chocolate 0.5 as opposed to 0.125 euros. So each plain chocolate is worth four milk chocolates. So the base year box has the equivalent of 60 milk chocolates, and the later year box has 108. The change in quantity is therefore $108/60 = 1.8$ or 180 with base as a 100.

The example is set out in the table below, showing a time series for the change in chocolate mix from the base year to the later year.

Chocolate box volume change**Prices in Euros**

	Base year T	T+1	T+2	T+3	T+4	Later year T+5
No. of milk chocolates	20	18	16	10	6	4
Milk chocolate index	100	0.9	0.8	0.5	0.3	0.2
Price of milk chocolate	0.125	0.125	0.125	0.125	0.125	0.125
Cost in box	2.5	2.25	2	1.25	0.75	0.5
No. of plain chocolates	10	12	14	20	24	26
Plain choc index	100	1.2	1.4	2	2.4	2.6
Price of plain choc	0.5	0.5	0.5	0.5	0.5	0.5
Cost in box	5	6	7	10	12	13
No. of chocolates in box	30	30	30	30	30	30
Average price of chocolate	0.25	0.275	0.3	0.375	0.425	0.45
Cost of box	7.5	8.25	9	11.25	12.75	13.5
Quantity index of box	100	100	100	100	100	100
Quantity index with choc type	100	110	120	150	170	180

The same principles apply in allowing for a change in quality of education. If it is government policy to move from low cost social science subjects to physical science subjects, which come at a higher cost, but the government believes this policy will be good for the economy and society, then the volume change in the provision of education can be best measured through stratification by type – capturing the change in quality of the move to the more costly education type. The higher cost reflects the price the government is prepared to pay.

Education volume change**Prices in euros**

	Base T	T+1	T+2	T+3	T+4	T+5
No. of pupils studying social science (thousands)	20	18	16	10	6	4
Social science pupil index	100	90	80	50	30	20
Cost per pupil	125	125	125	125	125	125
Total cost of social sciences (m)	2.5	2.25	2	1.25	0.75	0.5
No. of pupils studying physical sciences (thousands)	10	12	14	20	24	26
Physical science pupil index	100	120	140	200	240	260
Cost per pupil	500	500	500	500	500	500
Total cost of physical sciences (m)	5	6	7	10	12	13
Total number of pupils (thousands)	30	30	30	30	30	30
Cost of teaching per pupil	250	275	300	375	425	450
Total cost (m)	7.5	8.25	9	11.25	12.75	13.5
Quantity index of education	100	100	100	100	100	100
Quantity index of education, stratified	100	110	120	150	170	180

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Many papers on the development of Producer Price Indices for services can be found on the website of the Voorburg Group on Service Statistics

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Non-market services

At the annual OECD meetings many papers on development in measuring non-market services were presented, see above for the link.

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OECD (2011) *A System of Health Accounts*

<http://www.oecd.org/els/health-systems/asystemofhealthaccounts2011.htm>

D.M. Cutler and E.R. Berndt (Eds.) (2001) *Medical care output and productivity*, University of Chicago Press (see <http://www.nber.org/bookstoc/medoutput.html> for the table of contents)

J.E. Triplett (Ed.) (1999) *Measuring the prices of medical treatments*, Brookings Institution Press

http://www.brookings.edu/~media/research/files/papers/2009/11/22%20health%20system%20productivity%20triplett/1122_health_system_productivity_triplett.pdf

P. Schreyer (2012), *Output, outcome and quality adjustment in measuring health and education services*. Wiley Online Library
<http://onlinelibrary.wiley.com/doi/10.1111/j.1475-4991.2012.00504.x/full>