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Handbook on industrial producer price indices (PPI)

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Foreword

In 2002, the European Commission set up a list of key infra-annual macro-economic indicators, called principal European economic indicators (PEEIs). One of these indicators is the domestic producer price index (PPI) also known as the domestic output price index.

At the short-term statistics working group in December 2007, Eurostat presented the outcome of an analysis on the non-domestic PPIs, which in some cases showed diverging trends between countries. Similar divergences were observed, although to a smaller extent, also for the domestic PPIs. Further investigations concluded that the different price developments partly arose from methodological differences from country to country.

In answer to the observed issues, a task force on PPIs was organised in order to exchange best practices and discuss typical methodological issues relating to PPIs. The PPI task force met a total of three times in 2009 and 2010.

The main outcome of this task force is the present handbook that: brings together best practices in the Member States; extended methodological guidelines; practical examples; and international recommendations concerning the PPIs, in particular Eurostat, International Monetary Fund (IMF) and United Nations (UN) recommendations. The handbook is organised according to the main discussion topics as included in the mandate of the task force.

This handbook aims to serve as a tool for improving the quality of the PPIs in the reporting countries.

Sophie Limpach
Head of Unit
Short-term statistics; Tourism

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Introduction to PPIs

Liliana Apostol, Brian Newson (Eurostat)

Part I Price-determining characteristics

Aldona Spurgeviciene (Statistics Lithuania)

Part II Sampling

Liliana Apostol (Eurostat), Joen Joensen (Danmarks Statistik), Gerda Gladis (Statistisches Bundesamt, Germany)

Part III Data collection and processing

Data collection and processing overview: Gerda Gladis (Statistisches Bundesamt, Germany), Leo Enthoven (Centraal Bureau voor de Statistiek, the Netherlands)

Treating item non-response and unique products: Ingrid Vrabec (Statistik Austria)

Pricing industrial services: Gergana Maeva (National Statistical Institute, Bulgaria)

Transfer prices: Liliana Apostol, Brian Newson (Eurostat)

Part IV Quality change

Gerda Gladis (Statistisches Bundesamt), Toni Udd (Statistics Finland), Lewis Conn (ONS, the United Kingdom)

Part V Index compilation and revisions

Index compilation: Valerio de Santis (ISTAT, Italy)

Revisions: Liliana Apostol, Brian Newson (Eurostat)

Editorial work and layout

Ulrich Eidmann (Eurostat), Simon Allen and Giovanni Albertone (Informa s.à r.l.).

Contents

The handbook

Purpose and structure of the handbook

The present handbook focuses on methodological aspects of the industrial PPIs. It extends the guidelines in the short-term statistics (STS) methodological manual building on best practices in the Member States and taking account of recommendations in the Producer Price Index Manual of the IMF (hereafter IMF manual on PPIs).

The handbook contains nine chapters organised into five parts. Most of the chapters are broadly organised according to a common structure: introduction, methods, methods applied in practice (based on surveys of country practices or examples), and recommendations.

Terminology

The separate chapters in this handbook were initially drafted as a collection of subject-specific papers by several different authors. The initial drafts have been edited to produce a more homogeneous structure and style and to reduce overlapping/repetition. The editing has also included the harmonisation of a number of specific terms – the main ones are listed below. When the handbook contains verbatim extracts from other reference materials (such as manuals) these generally have not been edited, and so different terms may be used.

Selection of key words

Activity	**1. Used to indicate any level of an activity classification such as statistical classification of economic activities in the European Community (NACE); used in the same way as the word industry in the international standard industrial classification of all economic activities (ISIC).** **2. Used in a general way to refer to the population of units classified to a particular NACE heading instead of the words branch or sector which might be interpreted as implying the use of a particular type of statistical unit.**
Product or product heading	**Used to indicate a product at any level of a classification such as the classification of products by activity (CPA) or a list such as Prodcom.**
Product (business perspective)	**Indicates any good or service produced by a unit – a producer might identify several different products in its product range that all belong to one single product heading even in the most detailed of statistical classifications.**
Reporting unit	**Technically a reporting unit (that reports information) can be different from an observation unit (the unit about which information is observed and then reported) – for reasons of simplicity in this handbook they are simply referred to as reporting units.**
Representative products	**Also known as product representatives or price representatives.** **The precise product selected (normally by the reporting unit and/or statistical office) for which prices will be quoted. See also transactions.**
Section, Division, Group, Class, Category	**Used to indicate a specific level of a classification in accordance with the naming convention of NACE and CPA, such as group for 3-digit headings and class for 4-digit headings**
Transaction	**For the purpose of measuring prices for a PPI, a transaction is referred to here as the combination of i) a precisely defined representative product ii) traded under precisely specified transaction (or sales) conditions.**

Special note on (types of) statistical units

In a few places the handbook refers to specific types of statistical units, such as the enterprise or kind of activity unit (KAU). These terms are used in the sense of Council Regulation (EEC) No 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community.

Early drafts of this handbook used a mixture of terms such as enterprise, establishment, company, undertaking, firm, business, often seemingly interchangeably.

- Some of these are not true statistical units (such as company which is a legal form, like partnership or sole trader).
- Others are generic terms with no precise statistical definition in EU statistics (firm and business).
- Others were previously used in EU statistics but not since the 1993 Regulation on types of statistical units which established a single typology: notable examples are the term enterprise which was preferred to undertaking and local KAU which is used rather than the establishment.

It should nevertheless be noted that many of these terms may have precise statistical definitions in national statistics or in other international statistics, notably the term establishment which is widely used. In some cases these terms have distinctly different meanings in different countries, again notably the case for the establishment.

Except where the precise choice of type of statistical unit is essential this mixture of terms has been replaced by the editors by referring simply to the producer or to the reporting unit, without specifying the type of statistical unit. Where a verbatim quote has been included, for example from other international manuals, the type of statistical unit has not been edited.

In the case of collecting prices the choice of type of statistical unit to report prices may be considered to be relatively unimportant as it is the price of products (not a stock or flow relating to the statistical unit itself) that is observed and reported. The choice of type of statistical unit is however important for the development of a system of weights when producing PPIs, in particular for activity-based PPIs.

Producer price indices in the European Union

Legal base for PPIs

As for other STS indicators, the compilation of the PPIs is essentially made on the basis of a few important documents:

- STS legal acts, notably the STS Regulation and the implementing Commission Regulations, for example on the definition of the indicators;
- Methodology of short-term business statistics, interpretation and guidelines, edition 2006 (the STS methodological manual), providing detailed methodological guidelines concerning short-term business statistics.

The Council Regulation 1165/98 concerning short-term statistics (hereafter referred to as the STS Regulation) requires the EU Member States to deliver output price indices: these are also known as producer price indices (PPI) and that is the term used throughout this handbook. The indices must be compiled for industry (according to the requirements of annex A of the STS Regulation) and other services (annex D) – note that this handbook focuses on industrial PPIs.

Requirements

The STS Regulation establishes which indices are to be provided, as well as the level of detail, the frequency, the type of index and the deadline for providing short-term statistics. The requirements depend to some extent on the size of the Member State and whether the Member States is a member of the euro area or not.

All EU Member States have to supply domestic and non-domestic PPIs, as well as a total that is effectively a compilation of these two indices. The euro area Member States have to provide a further breakdown of the non-domestic PPI to distinguish between products sold (to other countries) within the euro area and those sold outside of the euro area.

STS variables

Name	STS regulation code	Database code
Producer prices (total)	310	pron
Domestic producer prices	311	prin
Non-domestic producer prices	312	pren
Non-domestic producer prices: euro area	(312)	prez
Non-domestic producer prices: non-euro area	(312)	prex

The legal requirements depend also on the size of the country, bigger countries being obliged to deliver more detailed indices and smaller countries being permitted a longer period to compile and transmit the data. The table below shows the classification of EU Member States into three groups to determine the level of detail required: the criteria for making groups for extended deadlines are similar.

Groupings of Member States

Group	Definition in terms of share of EU value added	Group members (base year 2005)
I	Less than 1 % in Sections B to E	Bulgaria, Estonia, Greece, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Romania, Slovenia and Slovakia
II	1 % or more in Sections B to E & less than 4 % in Section C	Belgium, Czech Republic, Denmark, Ireland, the Netherlands, Austria, Poland, Portugal, Finland and Sweden
III	4 % and more in Section C	Germany, Spain, France, Italy and the United Kingdom

For the extended deadlines, the threshold between groups II and III is less than 3 % of value added in Sections B to E rather than 4 % in Section C: there are three Member States falling between these two thresholds and therefore face the Group III requirements for stricter deadlines, namely the Netherlands, Poland and Sweden.

Summary of requirements

Common requirements

Scope	NACE Rev. 2 Sections B to E excluding Classes 07.21 and 24.46, Groups 25.4, 30.1, 30.3 and 30.4 and Divisions 37, 38 and 39
Observation unit	kind-of-activity unit (KAU)
Form	as an index, unadjusted (also known as gross)
Frequency/periodicity	monthly

Level of activity detail by country group

Country group	Level of detail
I	Total Industry, MIGs and NACE sections (1-letter)
II	as Group I plus NACE divisions (2-digit level)
III	as Group II plus NACE groups and Classes (3 and 4-digit level) within Section C representing (together) at least 90 % of total value added of Section C (note this extra detail is not required for the non-domestic producer price indicators split between euro area and non-euro area).

Timeliness by indicator and country group

	Country groups I and II	Country group III
Producer prices (total)	1 month, 15 days + 15 days	1 month, 15 days; 15 days extra for data at the 3 and 4-digit levels
Domestic and non-domestic producer prices	1 month, 5 days + 15 days	1 month, 5 days; 15 days extra for data at the 3 and 4-digit levels
Domestic and non-domestic producer prices	1 month, 5 days + 15 days	1 month, 5 days; 15 days extra for data at the 3 and 4-digit levels

Definitions of indicators

Note: in line with the STS regulation itself, the legislation on definitions refers to output prices rather than producer prices.

Output price (variable 310 in the STS Regulation)

It is the objective of the output price index to measure the monthly development of transaction prices of economic activities.

The domestic output price index for an economic activity measures the average price development of all goods and related services resulting from that activity and sold on the domestic market. The non-domestic price index shows the average price development (converted to local currency) of all goods and related services resulting from that activity and sold outside of the domestic market. When combined, these two indices show the average price development of all goods and related services resulting from an activity.

It is essential that all price-determining characteristics of the products are taken into account, including quantity of units sold, transport provided, rebates, service conditions, guarantee conditions and destination. The specification must be such that in subsequent reference periods, the observation unit is able uniquely to identify the product and to provide the appropriate price per unit.

The following rules apply for the definition of prices.

- The appropriate price is the basic price that excludes value added tax (VAT) and similar deductible taxes directly linked to turnover as well as all duties and taxes on the goods and services invoiced by the unit, whereas subsidies on products received by the producer, if there are any, should be added.
- If transport costs are included, this should be part of the product specification,
- In order to show the true development of price movements, it should be an actual transaction price, and not a list price,
- The output price index should take into account quality changes in products,
- The price collected in period t should refer to orders booked during period t (moment of order), not the moment when the products leave the factory gates,
- For output prices of the non-domestic market, the price should be calculated at national frontiers, FOB (free on board).

The index should in principle reflect the average price during the reference period. In practice the information actually collected may refer to a particular day in the middle of the reference period that should be determined as a representative figure for the reference period. For products with a significant impact on the national economy that are known to have, at least occasionally, a volatile price development, it is important that the index does indeed reflect average prices.

Output prices of the domestic market (311) and output prices of the non-domestic market (312)

The objectives and characteristics of indices for variable 310 (output prices) also apply to the indices for the distinction between domestic and non-domestic output prices.

The indices of domestic and non-domestic prices require separate output price indices to be compiled according to the destination of the product. The destination is determined by the residency of the third party that has ordered or purchased the product. The domestic market is defined as third parties resident in the same national territory as the observation unit. Output prices for the non-domestic market are further sub-divided into output prices for products despatched to euro area countries (312z) and all other output prices (312x).

Source: Commission Regulation (EC) No 1503/2006 of 28 September 2006 implementing and amending Council Regulation (EC) No 1165/98 concerning short-term statistics as regards definitions of variables, list of variables and frequency of data compilation.

Purpose of PPIs

Use and users of PPIs

Monthly measurement of producer prices meets the need for information on the short- and medium-term economic activity at national level and for the EU and euro area. The PPI data are widely used by both the business community and government, and enable monthly monitoring of prices at different stages of the industrial process.

There are three major uses of PPIs.

- As an economic indicator, PPIs capture price movements prior to the wholesale or retail level. Therefore, they may foreshadow subsequent price changes for businesses and consumers. They can be an early indicator of inflationary pressures in the economy. These data are used in formulating fiscal and monetary policies.
- As a deflator of other economic series, PPIs are used to adjust other economic time series for price changes.
- As the basis for indexing prices in contracts (escalation or indexation), PPI data are commonly used in indexing purchase and sales contracts. These contracts typically specify amounts of money to be paid at some point in the future. It may be agreed to include an indexation clause that takes account of changes in prices, for example of selected inputs.

In many countries, there is a big demand for PPIs from business and trade organisations. In most countries, these indices have already been in existence for decades and are part of economic life for national accountants and businesses. For these uses they need to be maintained by national statistical offices at a detailed level. For this reason, many medium-sized and small countries calculate detailed PPIs beyond the requirements of the STS Regulation in order to satisfy a national demand.

Activity and product PPIs

Different PPIs may be constructed to serve different purposes; therefore, the decision to compile a certain type of PPI must be taken according to what the main use of that indicator is going to be. As an illustration, PPIs constructed with the main purpose of deflating STS indicators may be different from PPIs constructed to deflate national accounts indicators, or to serve as indicators of price change in various markets.

The main distinction that can be made is between activity-based PPIs and product-based PPIs. The essential difference between these is the type of weights used to aggregate detailed price information into higher level indices. In both cases prices are observed for particular products (more precisely for representative products); a time series of this price information can then be produced relative to the price at a particular moment in time (such as the beginning or end of the series, or some other fixed point) and this is called a relative. The relatives for many different products can then be combined using weights – at a detailed level these weights are normally product weights, but at a certain level of aggregation (typically 4-digit level) it is possible to use either activity or product weights.

The STS Regulation requires PPIs presented broken down by activity and based on the KAU. Generally, when the observation unit (for the weights) is the KAU, the differences between product-based and activity-based PPIs may be expected to be quite small.

Furthermore, there may be differences between PPIs compiled for deflation purposes and PPIs compiled for indexing prices in contracts. The former may be based on the basic price concept (assuming that the indicator to be deflated is also valued at basic prices) in other words excluding non deductible taxes plus subsidies on the products, while the latter would normally be valued at the purchaser price.

I

Price-determining characteristics

Chapter 1 Price-determining characteristics

Introduction

PPIs are intended to measure a pure price change. The products (goods and related services resulting from an activity) whose prices are collected and compared in successive time periods should be identical in respect of their technical (physical) and economic (transaction) characteristics. To ensure consistency in the final index, the price observations should compare like with like for each period. A price observation is defined as the net revenue accruing:

- to a specified producer,
- from a specified kind of buyer,
- according to specified transaction terms,
- of a specific product,
- at the point in time or for the period of price collection.

The aim of this chapter is to analyse the possible approaches to detail price-determining characteristics and to ascertain the best practices used in the Member States.

Methods

Description of the methods

An analysis of the breadth of the product specification is provided by the United Nations manual on producers' price indices for industrial goods, New York, 1979.

'The first question that arises is whether the item specification should be drawn up in great detail or prepared on a relatively broad basis. There are advantages and disadvantages in both approaches. If the specifications are highly detailed – e.g., "men's shirts, non-sport, with collar, long sleeved, plain white, all cotton, non-shrink, non-crush" – the statistical office may have better control of the process and the collected prices may be sufficiently homogenous so that actual prices can be published. However, extremely detailed specifications may result in difficulties in collecting price observations, since the product may not be made by some producers or may not be made month after month. Furthermore, for some producers a very narrowly specified product may be incidental to its production of the eight-digit commodity group, and unrepresentative.

A broadly specified commodity on the other hand is more flexible and permits some adaptation to the circumstances of individual respondents. Then reporting arrangements must be made with each enterprise so that subspecifications within the specifications are determined. One respondent, for example, may report for low-priced shirts their prices while a manufacturer of a high-priced line reports for them. Obviously the statistical office has a more complicated task of controlling the operation, because it must ascertain that reporting units continue to price the identical items moth after month. A further drawback is that it is not feasible to publish the actual average price in such situations, since the prices collected cover a range of specifications within a commodity code.

In general, however, the advantages of broad specifications will usually outweigh the disadvantages, and it is probably the superior course for commodities for which it is not intended to publish average prices. It introduces greater flexibility in the programme, probably creates greater representativeness of reported prices and is likely to increase the number of usable observations.'

Technical characteristics (physical product specification)

All the relevant technical characteristics (physical product specification) of the product are to be provided describing the product, in other words all the information necessary to identify the selected product itself.

The description of products should specify (where applicable) brand name, type / model, design, size / dimensions / weight / power / capacity, other technical information, parts / attachments included, sort of raw materials, special features, composition, method of production, specific intended use / range of application, quality category / grade of the product, and so on. For example, if a producer charges more for a red widget than a white one, colour is one of the price-determining variables; if all widgets are sold for the same price regardless of colour, colour is not a price-determining variable. In the case of semi-processed goods or raw materials – for example flour or coal – the main characteristics can be described quite briefly; for more complex products – for example motor vehicles or machine tools – a more detailed description of technical characteristics is needed. For instance, in the case of a washing machine the information required for a precise specification may include make, model number, capacity, whether automatic, whether top or front loaded, and spin speed.

The description of industrial services may contain a complete description of the type of service being performed, a description of what is included in the service, a description and listing of component prices which together determine the final net price. The answers to the following questions indicate characteristics that should probably be included in the description.

- What characteristics does the reporting unit consider when setting the price of the service?
- What characteristics of the service would cause the price to change?

Some of the most common types of descriptive categories for services may be: component charges (type of labour and labour cost, type of material and material cost, miscellaneous features and charges included in the service, such as preparation, inspection, warranties, set-up costs), parts or equipment included/used in the service, location of the service, length of the service, frequency of the service.

Economic characteristics (transaction specification)

Identical economic characteristics (transaction specification) should include the terms and conditions of sale. Several types of characteristics can be considered.

Type of customer

The product was sold:

- on the domestic market
  - to other manufacturers
  - to wholesale enterprises
  - to retail enterprises
  - in the producer's own shops
  - other (reporting unit has to indicate)
- on the non-domestic market
  - (code of the destination country)

Note: a type of customer can refer to a group of similar customers or one particularly important customer (for example a particular wholesaler or retailer). If a product is sold in different countries either a single country is selected (for example with the highest sales value) or a weighted average can be calculated from prices for different countries.

Contract terms

Various types of contracts may determine the price, for example:

- no contract
- written contract
- purchase order
- other (reporting unit has to indicate)

Type of shipment

- single
- multiple
- other (reporting unit has to indicate)

Note: multiple shipments means that an entire order is not delivered at one time, but is staggered over a period of time. Higher prices may be charged for multiple delivery orders covering longer periods, because suppliers try to cover themselves against possible price rises.

Measurement unit and quantity

The price of the product may vary with different shipment sizes. The reporting unit has to select the most frequent:

- physical quantity (for example kg, m, m^2, m^3, piece, pair)
- quantity of sale (for example single units, hundreds, thousands)

Terms of payment

- in advance
- outright, in cash
- within 30 days
- other (reporting unit has to indicate)

Terms of delivery

- delivery up to the customs border of the country
- delivery on board ship (at FOB prices)
- delivery to the client
- without delivery to the client
- other (reporting unit has to indicate)

Generally delivery charges should be excluded from the reported price. A price including delivery is preferred only when delivery is an integral part of the product itself. This is a case only when both of the following conditions are met:

- the reporting unit delivers the product itself,
- it is impossible to separate delivery revenue from product revenue.

Type of price

- contract price
- average price (of a day or of a month)

- list price
- transfer price
- other (reporting unit has to indicate)

An average price reflects more than one transaction over a consistently defined time period. It has to be calculated by weighted arithmetic average formula.

List prices should be avoided if they do not reflect real transactions concluded.

Transfer prices (for products provided by one part of an enterprise (or enterprise group) to another) may be the only available market price proxies. They should be used with caution, only after careful attention has been paid to market price movements for similar products to ensure that these sales reflect market conditions.

Type of discounts

- seasonal
- quantity
- trade
- for payment in advance
- for cash payment
- other (reporting unit has to indicate)

A seasonal discount is offered at certain times during the year: it reflects seasonally-recurring and generally predictable changes in supply and demand.

A quantity discount is based upon the size of the shipment or order.

A trade discount is given to a particular class of buyer.

Other economic characteristics (transaction specification)

Various other characteristics may play a role in determining prices, for example:

- mode of dispatch (forwarding agent, rail freight, cash and carry, etc.)
- means of transport (own motor truck, own fuel tank truck, etc.)
- type of packaging (bag, box, container, tank, can, pallet, etc.)
- currency (for example euro, US dollar, Japanese yen)

For some activities, a specification for a particular product may not be appropriate. For example, some activities produce goods or services on a made-to-order basis and the same product is not produced in successive periods: these may be referred to as unique products. Examples of this could be furniture, prepared feeds for farm animals, doors and windows. In these instances, a generic specification may be more appropriate or a specification for a standard (rather than specific) product.

Methods applied in practice

An inquiry on price-determining characteristics was sent to the 17 countries participating in the PPI task force. The completed questionnaires were received from 16 of them – some results are presented below.

Broadness of the specification of a representative product

Question. What is your opinion on the broadness of a physical product specification? (it should be very detailed / it should be relatively broad).

The vast majority of countries indicated that the specification should be very detailed in order to avoid mixed-products and mixed-customers, as well as to eliminate the effects of quality changes. It is necessary to know the specification in order to make sure that the product observed remains the same.

Finland noted that in practice it is often quite difficult to have detailed specifications and receive price data regularly, for example in the case of products that vary a lot depending on the customer and where the same customer only buys the product once.

Slovenia and Hungary indicated that the extent to which a specification is tight or loose depends mainly on the nature of the product and which elements determine its price. The specification for some products must be very detailed, as this is the only way to ensure that the price for the same product is reported every month. For example when a producer has many similar products but with different characteristics which also have an impact on the price, then the specification needs to be more detailed. A broad specification can be used in cases when a producer has a set of similar products with similar characteristics, which do not have much impact on price, but the sale of products depends more on market conditions. In such cases the product specification may be expressed something like 'Woman's skirt from silk and cotton, more than 60 % cotton, 1 piece'.

In some cases it is necessary to make compromises in specifications otherwise there will be a lot of missing prices. In order to avoid one-off products in the survey relatively broad specifications of the products may be accepted (this was indicated by Bulgaria, France and Lithuania). Units which often renew production may offer small homogenous product headings, such as 'Men's cotton long-sleeve shirt', 'Long half-woollen suit trousers for boys of school age', 'Children's synthetic warm overall with lining, zippers and hood, length: 122–140 cm' rather than specific products (such as brands or models). In this case an average price should be calculated (weighted arithmetic average) for the price survey.

Conclusion

The extent of the information necessary to identify the representative product depends on its nature, for example raw materials may be described quite briefly while more complex products need more detailed descriptions to include all characteristics that have an impact on price, without rejecting compromises.

Procedure for selecting representative products

Question. Do you use two separate questionnaires for a producer price survey: one for the selection of representative products, their description and specification, the other – for the collection of data on prices for the representative products selected?

Some countries (Bulgaria, Denmark, Spain, France, Lithuania, Hungary, Finland, Sweden and Turkey) use separate questionnaire for the selection of representative products, their description and specification. The procedure is the following: when representative products are to be selected for the first time, selected reporting units receive the questionnaires for selecting and specifying the representative products. Units are given the lists of the selected product headings (codes in CPA or Prodcom) and instructions how to select the representative products. Reporting units are asked to select the representative products from each product heading for monthly pricing, applying the following criteria:

- the product selected is as representative as possible; it accounts for a significant share in the reporting unit's product heading;
- it is quite possible that the selected product will stay on the market in the future as well;
- the price of the selected product can be quoted on a regular basis in terms of a given unit and quality.

Every representative product is precisely specified, very often in consultation with the statistical office by telephone or e-mail. In some cases the first time that the questionnaires are completed the selected reporting units are visited by staff of the statistical office.

Conclusions

Different designs can be used to make the questionnaire easier to complete for certain types of reporting units. For example, different designs could be used for different activities. Furthermore, a questionnaire with a checklist design that provides all the important specifications and price-determining characteristics can help reporting units and data collectors as they will be able to verify the transaction and provide any new specifications or changes to the price basis that may apply when a previous transaction is no longer available and a replacement is selected.

Question. If you do not use separate questionnaires for the selection of representative products, their description and specification, are price-determining characteristics listed in the questionnaire for the collection of data on prices?

In order to select representative products and describe their price-determining characteristics the statistical offices of some Member States (Czech Republic, Germany, Austria, Poland and Slovenia) arrange visits to units, communicate with them by telephone or e-mail, or get the information about some product prices and their characteristics from the internet or other media. In such cases price-determining characteristics mostly are listed in the questionnaire that is used for the collection of data on prices.

Conclusion

A personal visit to producers for the selection of representative products, their description and specification may be considered an ideal (but expensive) procedure; alternative approaches include the use of telephone, internet, fax and e-mail, but these may be less effective.

Overview of transaction specifications used by countries

Question. What transaction specifications do you use?

Many transaction specifications are considered as very important, especially type of customer, measurement unit, size of shipment, terms of delivery, type of price, type of discounts. Contract terms, type of shipment, terms of payment are considered mostly as irrelevant.

Type of customer

Most countries indicated that the type of customer is one of the most important transaction specifications. The vast majority of the countries distinguish only domestic and non-domestic customers. A total of seven countries (Czech Republic, Germany, France, Lithuania, Poland, Sweden and Turkey) also distinguish wholesalers, retailers, manufacturers and so on. In the Netherlands the distinction is made by type of activity, for example chemical manufacturing, metal manufacturing, or building. Five countries (Bulgaria, Czech Republic, Germany, Spain and Slovenia) carry out two separate surveys, one on domestic prices and the other on non-domestic prices.

Type of customer

Country	Domestic or non-domestic customer	Types of domestic customer (wholesalers, retailers, manufacturers, etc.)
BG	(separate survey)	
CZ	(separate survey)	
DK		
DE	(separate survey)	
ES	(separate survey)	
FR		
LT		
HU		
NL		(further division by activity)
AT		
PL		
SI	(separate survey)	
FI		
SE		
TR	(note, only domestic prices surveyed)	

Source: PPI task force

Measurement unit and quantity

It was widely indicated that the measurement unit and size of shipment depends on the type of products.

Terms of delivery

The statistical offices accept prices with various terms of delivery, for example delivery up to the customs border, delivery to the client, delivery on board ship if they have non-domestic prices. In some countries domestic prices may be reported either with or without delivery to the client.

Terms of delivery

Country	Delivery up to the customs border of the country	Delivery on board ship (at FOB prices)	Delivery to the client	Without delivery to the client
BG				
CZ				
DK	Reporting units choose			
DE	Some examples are given in the instructions for completing the questionnaire			
ES				
FR				
LT				
HU				
NL				
AT				
SI	Terms of delivery are not defined; prices reported must be for the same terms of delivery every month			
FI				
SE				
TR				

Source: PPI task force

Type of price

Some countries (Austria and Sweden) collect list prices with an indication of the discount. Turkey collects prices for three days (around the 5th, 15th, 25th days of the month) and averages these. If countries collect current average prices mostly they are an average for a month (ten countries); only three countries (Bulgaria, Lithuania and the Netherlands) indicated that the prices often are averages for a day.

Type of price

Country	Current average price of a day	Current average price of a month	List price	Transfer price	Other
BG					
CZ					
DK	Reporting units choose				
DE	Some examples are given in the instructions for completing the questionnaire				
ES					
FR			(tariff)		model prices, contract prices
IT	Did not indicate				
LT					contract prices
HU			(when it is transaction price)		contract prices
NL	(rarely)				tender prices
AT			(with indication of discount)		
PL					
SI					
FI				(if other types of prices are not available)	
SE			(deducted for rebates)		stock exchange quotations, model prices
TR	Average of 3 days or around these days (5th, 15th, 25th)				

Source: PPI task force

Discounts

Discounts are taken into account: these are mostly seasonal discounts, trade discounts, quantity discounts, for an advanced or cash payment. Commonly, discounts for an individual client are ignored; if the discount is applicable for all clients the price after deduction of the discount should be provided. Finland noted that using average prices may hide discounts.

Other economic characteristics used as transaction specifications

Some countries use characteristics such as the mode of dispatch or means of transport (Germany), type of packaging (Germany and Austria), kind of currency (Poland and Sweden).

Conclusion

When the list of price-determining characteristics is too detailed there is a risk that it is not possible to measure a transaction price, as it is difficult to ensure a monthly collection of the prices for transactions taking place under exactly the same conditions.

Recommendations

STS definition of the PPI

An enumeration of some price-determining characteristics is provided by the STS definition of the PPI.

It is the objective of the [producer] price index to measure the monthly development of transaction prices of economic activities. It is essential that all price-determining characteristics of the products are taken into account, including quantity of units sold, transport provided, rebates, service conditions, guarantee conditions and destination. The specification must be such that in subsequent reference periods, the observation unit is able uniquely to identify the product and to provide the appropriate price per unit.

Main IMF recommendations

The IMF manual on PPIs details the main criteria that can affect a product's price. As an example, the manual provides the PPI collection form from Statistics Canada.

Illustration 1: extract from the IMF manual on PPIs

Table 6.1. Criteria That Affect a Product's Price

Item	Criteria/Reason
Product name	Company's name for the product within the specified product group. This should ideally contain information on the model/variety of the product.
Serial number	For the company's reference. This allows for changes in product name.
Description	In addition to the product name, this gives an opportunity for the company to specify what (if any) enhancements or add-ons are included in the product. For example, with cars, a number of options are usually available (metallic paint, sunroof), all of which could affect the price of the product.
Size of transaction	The amount of the product sold in the transaction and whether volume discounts apply.
Units of sale	Units used in describing the product.
Class of customer	Some companies may have different pricing structures for different customers (for example, retail and trade). A reference number can be used to maintain customer confidentiality.
Discounts	Many companies offer trade, volume, competitive, or preferred customer discounts. All applicable discounts should be described.
Payment terms	Companies may have different prices for different payment or credit terms.
Carriage terms	Whether transport costs are included and what type of transport.
Currency	Currency the price will be provided in.

II

Sampling

Chapter 2 Sampling

Introduction

Producer price surveys are complex surveys, which normally involve several selection stages. As they are generally costly, producer price surveys are rarely exhaustive, most often being based on samples (probabilistic or non-probabilistic).

There are several factors which can influence the outcome of a price (sample) survey and should therefore be considered when designing it. Some important aspects to be clarified before designing the sample are for example: the objectives of the survey (main uses, level of detail, frequency desired), identification of the data to be collected, identification of the population and construction of the sampling frame, and the level of accuracy which most often is closely linked to the available resources. The level of detail will influence the size of the sample: the more detailed the level required the bigger will be the sample size.

For the EU Member States, several of these factors are pre-determined by their legal obligations. The STS Regulation establishes the level of detail, the frequency, the type of index and the deadline. According to the STS requirements, the producer price indices supplied by each country to Eurostat can be different according to the size of the Member State and whether it is in the euro area or not. The requirements as regards the level of detail increase with the size of the country: the smallest Member States have to supply data for the NACE sections and main industrial groups only while the largest countries must provide data down to the 4-digit level of NACE.

All Member States have to deliver producer price indices broken down into domestic and non-domestic markets, while those in the euro area have to provide a further breakdown of the non-domestic market between the euro area and the non-euro area.

The samples should be made representative at the level at which indices are needed:

- euro area, non euro area and domestic for a Member States in the euro area;
- non-domestic and domestic for Member States not in the euro area.

The total producer price indices are obtained by weighting the domestic and non-domestic indices.

Methods

When designing the sample, decisions should be taken about:

- the sampling frame(s);
- the sampling technique(s) (probabilistic/non-probabilistic, defining the strata and sample allocation between strata, the level of accuracy).

The sampling frame defines the target population (universe) from which the sample will be drawn. It (ideally) lists all the units in the population of interest, which are the units producing and selling products on the domestic and/or non-domestic market. The observation unit as it is defined by the STS Regulation is the KAU.

For the domestic market, the units are normally selected from the Statistical Business Register. For the non-domestic market, the units may be drawn based on foreign trade statistics.

The sample of products can be based on a list (such as Prodcom) or a classification (such as CPA). For the selection of the observation units/products, some countries use a subset of the Prodcom survey.

Stages of selection

Most often, the price information is collected from samples of observation units and products, selected normally in two stages. The order of selection can be different.

One approach involves:

- first selecting the observation units;
- then selecting the products and transactions to be priced for each of the observation units already selected.

An alternative approach involves

- first selecting products;
- then selecting the observation units who produce the products already selected, and identifying the transactions to be priced.

The first approach may be preferred when the priority is activity-based indices, while the second approach may be preferred when the priority is the product-based indices.

In practice, most of the EU Member States apply the second approach. The activity-based indices are normally obtained by combining detailed product-based PPIs using structural business statistics (SBS) or national accounts weights. The assumption is however that the product based and the activity based indices derived in this way are quite similar as long as the KAU is used as the type of statistical unit for the weights.

Selection techniques for products and units

The selection of observation units and products can be done using either probabilistic methods or non-probabilistic ones.

The advantages of the probabilistic methods are that they allow the assessment of the quality of the survey by means of the sampling errors and they reduce the risk of bias for the calculated indices. For business surveys probabilistic samples are most often optimised through stratification and/or the use of the probability proportional to size (PPS) methods. Both methods aim to improve the accuracy of the statistics estimated from the samples.

Probabilistic techniques

Two main stratification criteria used in business surveys are the economic activity (in particular if the observation units are selected in the first stage) or the category of products (if the products are selected in the first stage). Size criteria, such as the value of turnover or employment can also be considered as stratification criteria and contribute to a further optimisation of the samples. The selection of the observation units and/or products is made within each stratum. The Neyman allocation is a frequent technique used in the stratified sampling; this technique maximises the precision (or minimises the sampling error) when the overall sample size is fixed.

PPS sampling is another method frequently used in business surveys. It implies that the observation units and/or products are selected with probabilities proportional to the size of the population.

The sampling (of the observation units and/or products) can also be done by using non-probabilistic methods, also called purposive or judgemental sampling; in these cases, the units to be included in the samples are selected based on expert opinion. One of the main disadvantages of these methods is that they increase the risk of bias in the indices. Also, with non-probabilistic samples sampling errors can not be calculated which, besides providing information to users, could also help improve the sample allocation.

Non-probabilistic techniques

However, in practice non-probabilistic methods are frequently used in the producer price surveys.

The IMF manual on PPIs recognises that the use of the non-probabilistic methods in the price surveys is normally less risky than for other (business) indicators (see Chapter 5, 5.22):

'Price indices are an area of statistics where the risks in not having a probability sample are relatively low. The potential diversity of the change in prices charged by various producers of a given commodity over many time periods is relatively low. Compare this to the potential diversity for sales or capital expenditures of firms making the same product over the same period of time. The largest unit may become the smallest, and vice versa. Some may even abandon production of the commodity, and new firms may enter. In summary, the measurement of price changes appears to require less rigour with respect to probability sampling than do other areas of statistical measurement.'

The cut-off method is another strategy which is frequently used in business statistics. Generally speaking, it consists in setting a certain threshold, under which all the units (observation units or products) are excluded from the survey. Above the fixed threshold units can be selected for inclusion in the survey on a sample basis or an exhaustive (take-all sample) basis.

As an illustration of the cut-off method, one frequent approach in practice is to include in the survey the largest units until a certain level of turnover is reached in each activity stratum. First, all units are sorted in descending order according to the turnover, then the percentage of each unit to the activity total is calculated as well as a cumulative percentage. All of the largest units are selected until a pre-determined threshold in the cumulative percentage is reached, for example a cumulative percentage of 80 %.

In a similar manner, the products with the biggest level of sales can be selected until the cumulative percentage of the sales reaches a desired threshold.

By excluding all of the units below the threshold the probability of inclusion in the sample of those units becomes 0, which does not correspond to the principles of a probabilistic method. The main criticism of cut-off methods is one which concerns the non-probabilistic methods in general, namely the risk of biased estimates.

In spite of the criticism, the cut-off approach may be considered to be useful for practical reasons. The cut-off methods normally exclude the smallest units which are subject to rapid changes (they can change their activity or disappear faster than big units), which therefore makes them very difficult to track. From this point of view, the inclusion of small units in samples may be considered inefficient in terms of data collection costs. The biggest non-response rates are normally recorded for the small units, which may feel overburdened. The statistical problem (bias) is that small units may have different price developments compared to big units. It may be considered unlikely that the small and big producers charge very different prices or that these develop differently.

Contacting reporting units and selecting transactions of representative products

Whether products or units are sampled first, the last selection stage normally is to select specific transactions with each unit – during the regular data collection price quotes will be provided for these transactions rather than for a broadly defined product from a statistical classification or list.

Contacting selected reporting units

Each selected reporting unit has to be contacted in order to prepare price observations and there are different ways to achieve this step.

A technically good procedure is to visit each reporting unit which gives the staff of the statistical office the opportunity to explain in person the purpose and the importance of the index. At the same time the statistical office receives basic information on the reporting unit. During this bilateral discussion the reporting unit and the statistical office can jointly select the representative products that will be observed. This way of proceeding is used by the Netherlands and France as they noticed that using telephone contacts for this purpose was not practical in most cases due to misunderstandings. Both countries have a

division specialised in introducing units to statistical surveys in general. Every new reporting unit is contacted by this division and most follow-up visits are made by them as well.

However, visiting each reporting unit can be very time consuming and expensive and an alternative procedure for introducing reporting units to the survey is by telephone. Here there is also personal contact to answer any specific questions raised by the reporting unit concerning the survey. In Germany for example reporting units are first contacted by a request in writing in order to fulfil the legal obligation to provide the reporting unit with all legal information, and this also includes the questionnaire and instructions.

Selection of transactions

The selection of a transaction involves identifying a certain representative product from the unit's product range that corresponds to the required product heading from the statistical classification and then defining precisely the sales (transaction) conditions of a typical transaction for this representative product. The selected representative product should have a high and stable importance regarding turnover such that it can be expected that the representative product will remain on the market for a relatively long time, have an unchanging quality and be sold at constant sales conditions. The price development of the selected representative product should be typical (representative) of similar products sold by the unit that are not selected.

The transaction has to be described in enough detail to guarantee statistical comparability over a time period. The description includes the exact specification of the selected representative product and also the description of the sales conditions such as the type of purchaser, the mode of dispatch, reductions, packaging, the physical unit, the quantity of purchase and the payment conditions. All these aspects form an integrated whole called 'price-determining characteristics' (see also chapter 1).

Defining a transaction – a representative product and its associated conditions – in this exact way makes it easier in case of price changes to distinguish between i) changes of the representative product itself or its sales conditions (quality change) and ii) a pure change of the price which is what is of interest when calculating the index (see also the chapter concerning quality adjustment).

The result of sampling: the basket, reporting units and transactions

The selected units are the reporting units: for the PPI they are normally producers of industrial products.

The selected products may be referred to as a 'basket'; the individual product headings within the basket are often called basket items. The product headings in the basket are normally defined at a detailed level (often 8-digit level of the Prodcom list, or even a more detailed level based on national classifications). At the stage of index compilation (see chapter 9) this detailed level of the product list or classification is normally referred to as an elementary aggregate.

Generally, for each item in the basket (therefore for each elementary aggregate) one or more transactions are selected for which individual prices (price quotes or notifications) will be collected. Each transaction concerns a representative product with specific sales conditions.

Sample maintenance

Another important aspect to be dealt with in particular in the price sample surveys is the maintenance of the sample. Because the sample of products and observation units is subject to depletion over time a programme for updating the sample is needed.

Methods applied in practice

The information in this section is extracted from two sources. One is the 'PEEI in focus – a summary for the domestic producer price index' produced in 2007. The PEEI in focus provided detailed information on the methods and sources for the domestic producer price index for 26 EU Member States, Norway, Switzerland, Croatia and Turkey. The information was collected in 2006 and 2007 and concerned the data in NACE Rev. 1.1. Please note that the tables have been reformatted to be integrated in the present

handbook. The second source is information provided by participants to the PPI task force held in 2009 and 2010.

Sources of the basic data

The table below shows that 23 countries use exclusively statistical surveys for compiling the domestic PPI. In the remaining countries some data (generally a small proportion) come from other sources, in several cases for energy products. In nearly all countries data collection is monthly, the exceptions being Cyprus, the Netherlands, Finland and Switzerland where some data are collected less frequently.

Overview of sources and frequency

	Main sources	Frequency
BE	Statistical surveys (80%); PRODCOM survey (10%), VAT turnover (5%), Energy department of Ministry of economical affairs (additional sources) 5%	Monthly
BG	Statistical survey carried out by National Statistical Institute	Monthly
CZ	Statistical survey carried out by the Statistical Office (95%), administrative source (5%)	Monthly
DK	Statistical survey (99.8%) and prices from Internet (0.2%)	Monthly
DE	Statistical survey carried out by the Federal Statistical Office	Monthly
EE	Statistical survey	Monthly
IE	Statistical survey carried out by the Central Statistics Office of Ireland	Monthly
EL	Statistical survey	Monthly
ES	Statistical survey	Monthly
FR	Statistical survey carried out by the public administration	Monthly
IT	Statistical survey	Monthly
CY	Statistical sample survey in manufacturing and mining; consumption data in value and quantity from the single electricity company; statistical survey of the 10 water companies	Monthly for mining and manufacturing; two-monthly for electricity; monthly for water except for desalination which is quarterly
LV	Statistical survey	Monthly
LT	Statistical survey carried out by Statistics Lithuania	Monthly
LU	Statistical survey	Monthly
HU	Statistical survey carried out by the staff of the Hungarian Central Statistical Office	Monthly
NL	Statistical survey	18% collected monthly, 59% quarterly, 18% half-yearly and 5% yearly: the indices are compiled monthly
AT	Statistical survey by the statistical office	Monthly
PL	Statistical survey conducted by the Central Statistical Office of Poland	Monthly
PT	Statistical survey	Monthly
RO	Statistical survey carried out by NIS	Monthly
SI	Statistical survey (CENE-DOMA/M) carried out by the national Statistical Office of the Republic of Slovenia	Monthly
SK	Statistical survey	Monthly
FI	Statistical survey	All price indices are produced monthly; approximately 23% of the prices are collected monthly (weighted share of 46%)
SE	Statistical survey	Monthly
UK	Apart from a statistical survey, a very small amount of data is gathered from other sources, for example from the London Metal Exchange; energy data are collected by the Department of Trade and Industry (DTI) and the Department for Environment, Food and Rural Affairs (DEFRA) supply agricultural prices; information provided in PEEI in focus mainly concerns the statistical survey	Monthly
NO	Statistical survey; in addition a minor amount of data is gathered from other sources, for example from the London Metal Exchange and the Bureau for Labour Statistics; energy data is mainly gathered from Nordpool	Monthly
CH	Statistical survey carried out by the public administration (95%), statistical survey carried out by trade organisations (5%)	Monthly, quarterly or half-yearly depending on price fluctuations of product groups; indices are compiled monthly
HR	Statistical survey	Monthly
TR	Statistical survey	Monthly

Source: PEEI in focus (2007)

Population coverage

Statistical unit and coverage

The table below shows that generally countries aim to cover CPA/NACE Rev. 1.1 Sections C to E with the indices that they compile, but that there are many exceptions.

19 of the 30 countries reported that the population covered units within a particular activity range, while 11 reported that the population covered units producing products within a particular product range.

Unit and coverage

	Unit	Product coverage	Activity coverage	Observation units within the activity range specified	Observation units belonging to enterprises within the activity range specified	Observation units with products within the range specified
BE	Enterprise	CPA Sections C to E except Groups 12.0, 22.1, 23.3, 29.6, 35.1, 35.3, 37.1, 37.2; Divisions 10 to 12 do not exist	Sections C to E			
BG	Enterprise	CPA Sections C to E except Groups 12.0, 23.3, 29.6, 35.1, 35.3, 37.1, 37.2	NACE Sections C to E except Groups 12.0, 23.3, 29.6, 35.1, 35.3, 37.1, 37.2			
CZ	Enterprise	CPA Sections C to E, except 11.2, 12, 13, 14.3, 14.4, 14.5, 17.3, 17.6, 18.1, 18.3, 19.1, 22.3, 23.3, 24.2, 24.7, 29.6, 33.5, 35.1, 35.3, 35.5, 36.2, 36.4, 37.2	NACE Sections C to E, except 11.2, 12, 13, 14.3, 14.4, 14.5, 17.3, 17.6, 18.1, 18.3, 19.1, 22.3, 23.3, 24.2, 24.7, 29.6, 33.5, 35.1, 35.3, 35.5, 36.2, 36.4, 37.2			
DK	KAU	CPA Section C to E except Group 35.1	NACE Sections C to E except Group 35.1			
DE (1)	Local units	CPA Sections C to E, except 10.3, 11.2, 12, 13, 14.11, 14.13, 14.3, 15.94, 15.95, 17.52, 18.3, 20.5, 22.25, 22.32, 23.3, 25.12, 26.25, 27.33, 29.6, 33.3, 35.11, 35.3, 35.43, 36.21	NACE Sections C to E: 10.3, 11.2, 12, 13, 14.11, 14.13, 14.3, 15.94, 15.95, 17.52, 18.3, 20.5, 22.25, 22.32, 23.3, 25.12, 26.25, 27.33, 29.6, 33.3, 35.11, 35.3, 35.43, 36.21			
EE	KAU		Sections C to E			
IE	Enterprise and/or local unit		NACE Sections C and D except Groups 10.1, 10.2, 17.6, 18.1, 22.1, 22.3, 24.2, 26.3, 27.1, 27.2, 28.3, 28.4, 29.6, 31.5, 33.3, 33.5, 35.2, 35.3, 35.4, 35.5, 36.2, 36.3, 37.1			
EL	KAU	CPA Sections C to E	NACE Sections C to E			
ES	Local unit	CPA Sections C to E except 10.3, 11, 12, 13.1, 17.1, 17.2, 22.23-22.25, 23.3, 26.24, 2625, 26.66, 27.21, 27.35, 27.45, 27.5, 28.11, 28.4, 28.5, 29.21, 30.01, 35.2, 35.43, 35.5, 36.21, 37, 41	NACE Sections C to E except 10.3, 11, 12, 13.1, 17.1, 17.2, 22.23-22.25, 23.3, 26.24, 2625, 26.66, 27.21, 27.35, 27.45, 27.5, 28.11, 28.4, 28.5, 29.21, 30.01, 35.2, 35.43, 35.5, 36.21, 37, 41			

Unit and coverage (continued)

	Unit	Product coverage	Activity coverage	Observation units within the activity range specified	Observation units belonging to enterprises within the activity range specified	Observation units with products within the range specified
FR	Varies: the main criterion is that the unit is producing at least one selected product	CPA Sections C to E except Groups 10.2, 10.3, 11.1, 11.2, 12.0, 13.1, 13.2, 18.1, 22.1, 22.3, 23.3, 29.6, 33.5, 35.1, 35.3, 36.3, 37.1, 37.2, 40.3	NACE Sections C to E except Groups 10.2, 10.3, 11.1, 11.2, 12.0, 13.1, 13.2, 18.1, 22.1, 22.3, 23.3, 29.6, 33.5, 35.1, 35.3, 36.3, 37.1, 37.2, 40.3			
IT	Enterprise		NACE Sections C to E except Groups 12.0, 13.1, 23.3, 35.1, 35.2, 35.3			
CY	Enterprise		NACE Sections C to E			
LV	Enterprise		NACE Sections C to E, except Groups 12.0, 23.3, 29.6, 35.3, 37.2			
LT	KAU	Sections C to E except Groups 29.6, 35.1 to 35.3, 36.1 to 36.4, 37.2; no production in Groups 12.0, 13.1, 13.2, 23.1, 23.3 and 33.5				
LU	KAU		NACE Sections C to E except 10 to 13, 15.812, 15.813, 18, 19, 23, 29.322, 30, 32, 33.102, 35, 36, 37 which do not exist/are not considered to be industrial			
HU	Legal unit (enterprise), & some KAU	CPA Sections C to E, except 10.1; 12.0; 13.1; 14.3; 14.4; 14.5; 15.2; 23.3; 28.3; 33.3; 33.5; 35.1; 35.3; 36.3	NACE Sections C to E except 11.1; 12.0; 13.1; 14.3; 14.4; 14.5; 15.2; 22.1; 23.3; 28.3; 33.5; 35.1; 35.3; 37.2			
NL	Enterprise & parts of enterprises		Sections C to E except groups 12.0, 22.1, 23.3, 29.6, 35.1, 35.3, 37.1, 37.2			
AT	Kind of activity unit	CPA Sections C to E, except 12.0, 23.3	NACE Sections C to E			
PL	Enterprise	CPA Sections C to E except Groups 12.0, 22.1, 23.3, 29.6, 35.1, 35.3, 37.1, 37.2	NACE Sections C to E			
PT	Local KAU	CPA Sections C to E except 13.1, 18.3, 20.4, 29.1, 29.3 29.4 29.6, 31.1, 31.6, 33.3, 33.5, 34.2, 35.1, 35.3, 35.5, 36.3, 36.4, 36.6, 37.1, 37.2; no production in 10 to 12 23.1, 23.3	NACE Sections C to E except 13.1, 18.3, 20.4, 29.1, 29.3 29.4 29.6, 31.1, 31.6, 33.3, 33.5, 34.2, 35.1, 35.3, 35.5, 36.3, 36.4, 36.6, 37.1, 37.2; no production in 10 to 12 23.1, 23.3			

Unit and coverage (continued)

	Unit	Product coverage	Activity coverage	Observation units within the activity range specified	Observation units belonging to enterprises within the activity range specified	Observation units with products within the range specified
RO	Enterprise	NACE Sections C to E except Groups 12.0, 22.1, 23.3, 29.6, 30.0, 35.1, 35.3, 37.1, 37.2	NACE Sections C to E except Groups 12.0, 22.1, 23.3, 29.6, 30.0, 35.1, 35.3, 37.1, 37.2			
SI	Enterprise	Sections A to E, except 01, 05, 10.1, 10.3, 11, 12, 13, 14.3, 14.5, 17.3, 18.3, 20.5, 22.3, 23.1, 23.3, 26.7, 28.3, 33.3, 33.4, 33.5, 35.2, 35.3, 35.5, 36.3, 37, 40.2, 40.3; no production in 16	Sections A to E, except 01, 05, 10.1, 10.3, 11, 12, 13, 14.3, 14.5, 17.3, 18.3, 20.5, 22.3, 23.1, 23.3, 26.7, 28.3, 33.3, 33.4, 33.5, 35.2, 35.3, 35.5, 36.3, 37, 40.2, 40.3; no production in 16			
SK	Enterprise	CPA Sections C to E except 10.1, 11.2, 12.0, 17.3, 19.1, 22.3, 23.1, 23.3, 33.3, 35.5, 36.3, 37.1, 37.2.				
FI	Enterprise		NACE Sections C to E			
SE	Enterprise	Sections C to E except Division 37				
UK	Enterprise or a list of local units	Sections C and D except 10-13, 23.1	NACE Sections C and D except 10-13			
NO	Enterprise or local unit	Sections C to E except 12, 22.1, 23.3, 29.6, 35.1, 35.3, 41	Sections C to E except 12, 22.1, 23.3, 29.6, 35.1, 35.3, 41			
CH	Enterprise	Sections A and C to E, except 10 to 13, 14.3 to 14.5, 15.2, 17.3, 17.6, 18.1, 18.3, 20.5, 22.1, 22.3, 23.1, 23.3, 28.3, 29.6, 30, 35.1, 35.4, 35.5, 36.2 to 36.5, 37.2, 40.3, 41	Sections A and C to E, except 10 to 13, 14.3 to 14.5, 15.2, 17.3, 17.6, 18.1, 18.3, 20.5, 22.1, 22.3, 23.1, 23.3, 28.3, 29.6, 30, 35.1, 35.4, 35.5, 36.2 to 36.5, 37.2, 40.3, 41			
HR	Enterprise	Sections C, D and E, except 10, 12, 13, 23.3, 29.6, 35.1, 35.3, 37	NACE Sections C, D and E, except 23.3, 29.6, 35.1, 35.3, 37			
TR	Enterprise and KAU	CPA Sections C to E except 10.3, 11.2, 12.0, 15.2, 17.3, 17.6, 18.3, 20.3 to 20.5, 22.3, 23.3, 26.8, 28.3, 28.5, 29.6, 31.5, 33.3, 33.5, 34.2, 35.1, 35.3, 35.5, 36.2 to 36.5, 37, 40.3	NACE Sections C to E			

(1) Often enterprises bundle the price observations of their local units; note that KAU data is used for weights.

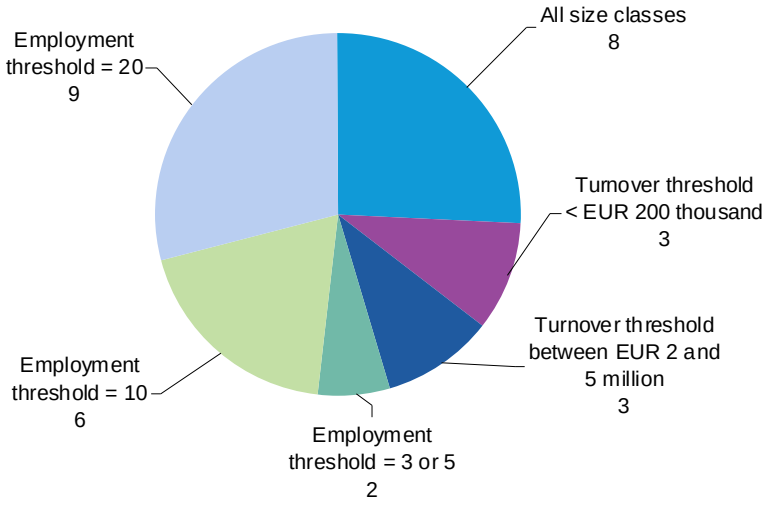
Source: PEEI in focus (2007)

Size coverage and other exclusions from the national population of interest

As well as determining the national population of interest in terms of activity or product range, close to three quarters of countries also limit their surveys to exclude smaller enterprises.

In more than half of all countries an employment threshold is used, normally 10 or 20 (employees or persons employed), while in one fifth of the countries an annual turnover threshold is used — see the figure below.

Count of countries with and without size thresholds (1)



(1) Note that in Belgium a threshold is used but details not specified; Denmark and Slovakia included twice because of a combined employment and turnover threshold.

Source: PEEI in focus (2007)

The table below provides information on the size thresholds used by each country, as well as showing other exclusions from the national population: in the Czech Republic natural persons are excluded, in Romania unincorporated enterprises are excluded, and in Finland output that is considered as defence production is excluded.

Size thresholds used by countries; other exclusions from the national population of interest

	Size coverage; other elements of coverage
BE	No threshold; enterprises subject to PRODCOM survey
BG	Enterprises with turnover of 75 thousand BGN or more
CZ	No threshold; natural persons are excluded (but these are included in weights)
DK	Enterprises with annual turnover < DKK 20 million (~EUR 2.7 million) and enterprises with < 20 persons employed are not selected as new price reporters
DE	Local units employing 20 persons or more (for some activities 10 persons or more)
EE	Units employing 10 persons or more
IE	Units employing 3 persons or more
EL	Enterprises with 10 and more employees and smaller units important in terms of production or sales values
ES	Local units employing 20 persons or more
FR	Units with a turnover > EUR 5 million
IT	No threshold
CY	No threshold; only Government controlled area of Cyprus covered
LV	No threshold
LT	Sections C and D: industrial units with annual sales > LTL 0.2 million; smaller industrial enterprises whose production is vitally important; non-industrial enterprises with annual sales of industrial activity > LTL 0.5 million Section E: no threshold
LU	No threshold
HU	No threshold
NL	20 or more employees
AT	Enterprises with at least 20 persons employed; the threshold may be lowered but not below 10
PL	Enterprises with 10 or more employees
PT	No threshold
RO	Enterprises with 20 employees and more; unincorporated enterprises of the household sector are excluded
SI	Enterprises and establishments with 20 or more employees
SK	Legal units with 20 and more employees; legal units with turnover < SKK 70 million (or sometimes 50 million) in 2000 are excluded
FI	Enterprises with turnover > approximately EUR 170 000 in 2000;defence production excluded
SE	Enterprises with 5 or more employees
UK	Units employing 10 persons or more
NO	Enterprises employing 10 persons or more
CH	No threshold
HR	Enterprises employing 10 persons or more
TR	Before 2004, enterprises with 10 or more employees; from 2004 enterprises with 20 or more employees

Source: PEEI in focus (2007)

Size of the national population of interest

Given the very varied use of size thresholds, and the differences in activity coverage the nationally defined populations are quite different. The table below shows the size of these populations in absolute terms (number of enterprises. The table also shows the coverage rates. Interpretation of these has to be careful. As has been noted above many countries use a size class threshold, and many also exclude some activities/products, and it is not certain that the coverage rates (which are measured in turnover terms) take account of both of these differences or just one of them.

Size of the national population of interest and coverage rates

	Number of units in the nationally defined population						Coverage rates (nationally defined population relative to full STS requirements) in terms of turnover (%)					
	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy
BE	15 202	4 157	2 116	802	3 624	77	89.4	93.9	90.4	88.0	91.1	82.2
BG	11 575	3 882	1 876	738	4 844	235	99.1	99.2	98.5	97.2	99.0	100.0
CZ	7 699	:	:	:	:	:	98	:	:	:	:	:
DK	2 806	1 058	853	222	658	15	85.4	88.9	92.0	88.6	99.0	28.8
DE (1)	40 868	14 776	11 302	1 882	9 578	3 330	102.5	99.6	99.3	99.4	114.9	99.8
EE	:	:	:	:	:	:	90	:	:	:	:	:
IE	5 293	2 364	1 169	507	2 250	0	66.3	72.4	72.9	58.5	56.3	0.0
EL	5 595	2 640	817	495	2 500	89	>90	:	:	:	:	:
ES	21 675	8 244	4 901	1 554	6 896	80	:	:	:	:	:	:
FR	23 474	:	:	:	:	:	99.7	:	:	:	:	:
IT	:	:	:	:	:	:	:	:	:	:	:	:
CY	6 337	2 117	1 142	877	2 188	13	100	100	100	100	100	100
LV (2)	:	:	:	:	:	:	100	100	100	100	100	100
LT (3)	3 517	1 349	396	280	1 398	94	94	91	98	98	90	99
LU	1 002	274	187	1	316	224	98.6	99.3	98.1	54.6	97.4	100.0
HU	8 973	3 233	2 200	462	2 818	260	~80	:	:	:	:	:
NL	6 200	:	:	:	:	:	80	:	:	:	:	:
AT	6 871	:	:	:	:	:	:	:	:	:	:	:
PL	30 228	:	:	:	:	:	:	:	:	:	:	:
PT	:	:	:	:	:	:	:	:	:	:	:	:
RO	10 611	3 652	1 400	663	4 520	376	:	:	:	:	:	:
SI	2 299	1 030	464	189	572	44	:	:	:	:	:	:
SK (4)	2 049	:	:	:	:	:	96	:	:	:	:	:
FI	:	4 848	608	2 438	3 613	69	:	:	:	:	:	:
SE	:	:	:	:	:	:	:	:	:	:	:	:
UK (5)	139 225	56 760	28 825	11 885	41 545	210	80	100	100	100	100	:

Note that the number of units in the population in total industry is less than in the main industrial groupings (MIGs) for some countries.

(1) The coverage rates above 100 % are due to the inclusion of NACE Rev. 1.1 Group 22.1 in the national coverage despite not being in the STS coverage.
(2) Coverage rate inferred from other information in the report.
(3) Coverage rates based on sales of industrial production.
(4) Data are for 2000 (base year)
(5) The number of units in the population and the coverage rates seem high given the use of a size threshold to determine the national population.

Source: PEEI in focus (2007)

Order of selection of observation units or products

Unlike most business surveys, producer price surveys are generally not simple surveys of units, but involve:

- selecting units who will provide the price information;
- selecting products (from a list such as a Prodcom List or a classification such as CPA);
- determining precisely the specification of the representative products for which observation units will give a price quote for each product.

The first two of these stages can be done in either order, namely i) selecting first the products and then the units that produce these products, or ii) selecting first the units and then identifying which products they produce. The table below provides an overview of the order in which these first two stages are performed in each country.

Just under three quarters of the countries select first the products to be surveyed and then find the appropriate units, while the remaining countries select first the units to be surveyed and then the products.

Overview of the order of selection of products and reporting units

	Products then observation units selected (level at which products/categories selected)	Observation units then products selected
BE		
BG		
CZ	CPA 6	
DK	HS 8	
DE		
EE		
IE		
EL		
ES		
FR		
IT		
CY		
LV		
LT		
LU		
HU		
NL		
AT	ÖProdcom 10	
PL		
PT		
RO		
SI		
SK	CPA 6	
FI		
SE		
UK		
NO		
CH		
HR		
TR		

Source: PEEI in focus (2007)

Selection of units

The table below is shown in three parts: 15 countries using sampling, two countries with an exhaustive coverage of the nationally defined population (the Netherlands and Slovakia), and 13 countries using a cut-off method of selection.

A small majority of countries using sampling techniques use purposive sampling, while the remainder use PPS.

Selection of observation units

	Threshold for take-all strata	If sample, basic method	Description
BE	Prodcom survey threshold	PPS	No specific strata
BG	None	PPS	PPS techniques involves identifying a stratum that will be selected with certainty (i.e. probability=1) and the remaining strata selected with probabilities based on their relative contribution to sales on domestic market. The number of the units selected in the sample depends on the degree of industrial concentration of the enterprises from each sampled Prodcom group. In production with high degree of industrial concentration (largest 5 enterprises have 75% of sales) only the largest enterprises are selected. Where the largest 5 enterprises have less than 75% of sales more enterprises are selected with PPS.
CZ	None	Purposive	Minimum 40% of domestic sales and minimum 5 units in each 4-digit CZ-CPA
DE	None	Purposive	The minimum numbers of price observations is determined: as a rule for each 0.01% of weight (of a given product) one observation unit is selected. Within each basket position (as a rule 9-digit heading of the national version of CPA) all local units are ranked by output and the largest one are chosen. Exceptions are possible when a high level of concentration is observed or when the price development in the past was largely the same for all observation units
EE	None	Purposive	Enterprises are chosen with a record of stable production and sales activity and large shares of sold production on the domestic market
CY	None	Purposive	Enterprises are selected that produce the selected products, with attention to larger units and units that export
LV	Varied	Purposive	Enterprises are chosen with a record of stable production and sales activity and a large share of sold production on the domestic market; Exhaustive if annual turnover exceeds LVL 100-700 thousand and persons employed 30-50 or more: thresholds vary between activities; sampling below these thresholds
LT	None	Purposive	Observation units are selected with a record of stable production and a large share of sales in the respective product heading; selected units should cover about 70-80% of sales in the product heading
LU	None	Purposive	
PL	None	Purposive	Selection criteria is based on the annual value of sold production of enterprises with more than 9 employees
FI	None	PPS and purposive	Strata are 3-digit NACE
SE	Varied	PPS	The sample is proportionally allocated to the different markets (domestic, export and import) according to the number of observations in the current PPI sample. From the fixed sample size, the average value that a price specification represented is calculated (“represented value”). For a stratum to be of acceptable quality it should contain at least 5 price specifications. The final stratum structure contains 110 strata. For each stratum a PPS sample (one step sampling) is drawn where the sampling unit is the combination of corporate identity number and CN8. Sampling probabilities for the sampling unit i, Ui = n × value /stratum value, where n is the sample size. If the sample size is 10 for a stratum and a sampling unit is 10 percent or more of total value then sampling probabilities are greater than 1. Then the object (sampling unit) will be chosen with certainty and is withdrawn before the PPS sampling
UK	None	PPS	The strata are based on the level of sales. Three size strata are defined within a product heading
NO	Local KAUs with more than 100 employee	PPS	All local KAUs over 100 employees are selected with certainty, and in four additional strata the PPS approach was applied
CH	None	Purposive	

Grey coloured rows indicate countries that first select observation units.

Source: PEEI in focus (2007)

Selection of observation units (continued)

	Description
NL	Exhaustive survey within the nationally defined population
SK	Exhaustive survey within the nationally defined population
DK	Varies: sufficiently large number of units selected top-down
IE	50% of turnover within each activity
EL	About 70% of turnover within each NACE class
ES	At least 60% within each 4-digit CPA
FR	At least 50% and most often 70% of the commodity group turnover is covered; other units may be selected to obtain a better coverage of a particular product family
IT	90% of value added within NACE Rev. 1.1 Section D
HU	Units that provide turnover data for products sold on the domestic market monitored by the Annual Product Statistics
AT	At least 3 (the most important) units within each product heading
PT	80% of the sales value within each product heading
RO	At least 60% of the sales value within each activity
SI	A minimum (unspecified) share of turnover within each activity
HR	A minimum (unspecified) share of production within each product (heading)
TR	At least 80% of the production/sales value within each Group

Grey coloured rows indicate countries that first select observation units.

Source: PEEI in focus (2007)

Size of the sample and coverage rates

	Number of units in sample						Coverage rates (share of turnover among selected units, relative to the nationally defined population) (%)					
	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy
BE (1)	1 395	468	183	78	293	2	47	36	41	24	46	70
BG	1 907	648	306	136	736	81	81	80	66	73	70	94
CZ	1 200	619	304	72	329	36	60	:	:	:	:	:
DK	748	276	185	66	211	10	64	56	47	54	76	85
DE (2)	7 270	3 087	1 817	429	1 322	615	74	72	89	73	60	55
EE	300	:	:	:	:	:	57	:	:	:	:	:
IE	909	486	234	83	318	0	66	72	73	59	56	~
EL	1 250	366	208	52	677	37	>70	>70	>70	>70	>70	>70
ES	8 650	3 883	1 094	737	3 101	67	:	:	:	:	:	:
FR	~3 200	:	:	:	:	:	65	:	:	:	:	:
IT	3 667	1 691	738	252	966	69	:	:	:	:	:	:
CY	280	98	38	23	117	4	:	:	:	:	:	:
LV	461	:	:	:	:	:	66	:	:	:	:	:
LT (3)	328	117	21	14	130	50	97	94	72	99	99	100
LU	122	60	28	1	25	8	83	90	69	100	69	85
HU	1 266	550	135	66	436	79	90	87	77	81	89	95
NL	4 500	:	:	:	:	:	90	:	:	:	:	:
AT	~1 400	:	:	:	:	:	53	:	:	:	:	:
PL	3 260	:	:	:	:	:	~70	:	:	:	:	:
PT	3 217	:	:	:	:	:	80	:	:	:	:	:
RO	1 666	597	251	112	608	98	75	96	81	92	76	51
SI	309	172	58	20	74	13	:	:	:	:	:	:
SK	598	292	114	30	182	38	81	:	:	:	:	:
FI	660	273	125	42	196	24	:	:	:	:	:	:
SE	3 700	:	:	:	:	:	:	:	:	:	:	:
UK	4 240	1 800	975	285	1 345	5	27	31	27	27	30	:
CH	1 450	:	:	:	:	:	:	:	:	:	:	:
HR	385	:	:	:	:	:	:	:	:	:	:	:
TR	1 455	:	:	:	:	:	:	:	:	:	:	:

Note: for a number of countries the relationship between the sample size and the population size does not appear to be consistent with the information given on the method of selecting units.

(1) Coverage rate for energy is estimated.

(2) Data refer to 2000 (base year). Based on enterprises - total turnover of an enterprise is included in the calculation of the coverage rate if at least one local unit of this enterprise is selected. For some products secondary sources are used for price observation (consumer prices, commodity-market quotations, hedonic regressions) - the number of units behind these calculations is not included in the data.

(3) Four units are included in more than one of the MIGs; coverage rates based on sales of industrial production.

Source: PEEI in focus (2007)

Sample size

The starting point for data collection is the sample of products, units and the selected representative products.

The size of the sample (number of reporting units included and number of price observations) varies between European countries. On average the number of price observations per reporting unit is between 1.5 and 5.5.

Sample sizes (approximate)

	Domestic market				Non-domestic market			
	price observations	units	observations per unit	observations / EUR billion turnover	price observations	units	observations per unit	observations / EUR billion turnover
BG	8 400	1 715	4.9	571.3	1 760	410	4.3	258
CZ	4 800	1 200	4	83.4	1 770	520	3.4	37.8
DK	2 000	620	3.2	38.7	1 200	330	3.6	24.7
DE	9 000	5 000	1.8	7.8	5 000	3 000	1.7	7.4
ES	28 300	9 020	3.1	69.9	15 690	4 250	3.7	125.3
IT	9 200	3 070	3	12	6 700	2 070	3.2	27.2
LT	1 100	470	2.3	177.6	650	290	2.2	96.5
HU	4 300	1 050	4.1	91.5	2 650	790	3.4	60.4
NL	9 000	2 680	3.4	61.2	6 200	1 950	3.2	44.7
AT	4 100	1 420	2.9	59.9	3 000	1 050	2.9	37.1
SI	1 600	310	5.2	165.1	730	210	3.5	57.8
FI	1 780	760	2.3	24.9	1 000	430	2.3	18.1
SE	1 800	910	2	18.3	1 330	360	3.7	14.1
UK	6 750	4 000	1.5	10.7	5 500	4 700	1.2	

	Combined domestic and non-domestic market			
	price observations	units	observations per unit	observations / EUR billion turnover
FR	24 000	4 400	5.5	25.8
PL	19 000	3 300	5.8	97.5
TR	4 070	1 480	3.2	

Source: PPI task force

Selection of products

The first table below shows the methods of selecting products in each country: in nearly every country a judicious sample or cut-off selection is used to select the largest products. The second table shows the level of detail at which products are selected – these are the elementary aggregates. The third table shows the number of selected products.

Selection of products (grey coloured rows indicate countries that first select products)

	Description	Sample frame for product selection
BE	The largest products are selected within each 4-digit NACE stratum.	Prodcom survey
BG	PPS	Product headings are sampled from the Prodcom survey; then for each group the sample of reporting units is made
CZ	The largest products are selected in each 6-digit CPA; after selection of observation units a judicious selection of products is agreed with the observation units.	
DK	Statistics Denmark select the product headings (HS 6-digit); after selection of observation units the observation units select suitable products.	Statistics Denmark select the product headings (HS 6-digit) from the Industrial Commodity Statistics
DE	In each CPA 4-digit, 9-digit (national) CPA products are selected to reach a cumulative share of at least 60% of production value; additionally products may be selected for important users. For 2000 (base year) selected products represent 79% of the total production value of CPA Sections C to E.	The annual results of the Prodcom survey are used
EE	Products are selected with high sales volume in the domestic market based on the Prodcom list.	
IE	A judicious selection of products is agreed with each observation unit.	
EL	Products are selected with high sales value during the base year (2000) - a threshold is set for the product to be selected.	The annual Prodcom survey results of the base year
ES	Cut-off sample of the largest products within each 4-digit CPA stratum.	Prodcom survey
FR	A judicious selection of products is agreed with each observation unit.	
IT	Cut-off sample of the largest products within each CPA stratum.	
CY	In each 4-digit activity the most important products (7-digit Cypriot CPA) are selected based on production value in the five yearly census; after selection of observation units a judicious selection of products is agreed with the observation units.	
LV	A judicious selection of products is agreed with each observation unit.	
LT	A judicious selection of products is agreed with each observation unit. The inquiry form for selection of specific products that have to be priced in each product heading are sent to selected observation units together with the lists of the sampled product headings (PGPK 10 digit level). The observation units are asked to supply a detailed specification of the most important variety that they consider will be produced throughout the coming year. In the case of a newly selected unit, the annual inquiry is undertaken with the assistance of staff of the Price Statistics Division of Statistics Lithuania.	
LU	A judicious selection of products is agreed with each observation unit.	
HU	At the 4 digit level the product headings are selected by judgmental sampling (the most important groups).	The annual Prodcom survey
NL	The sample is judiciously drawn so that the selected product groups cover about 80% of turnover	The Prodcom survey
AT	The data base for the selection of products and units is the PRODCOM survey. A cut-off sample of the most important product groups and most important units in each CPA stratum is used: 1. The most important CPA 6 digits per CPA 4 digit are selected: the production value of each selected CPA 6 digit covers more than 15% (threshold) of the production value of each CPA 4 digit. 2. The most important ÖPRODCOMS per CPA 6 digit are selected: the production value of each selected ÖPRODCOM covers more than 15% (threshold) of the production value of the CPA 6 digit. 3. For each selected ÖPRODCOM at least 3 of the most important units (with the highest production value) are selected.	The annual Prodcom survey

Selection of products (grey coloured rows indicate countries that first select products) (continued)

	Description	Sample frame for product selection
PL	Reporting units select representative products. First they select the kinds of activities which together amount to at least 70% of the total annual sales of the enterprise. Then on the basis of the present and foreseen structure of production they select product headings taking into account those groups with significant sales value in their industrial activities (the target is that the sum of the selected product headings amount to at least 60% of the value of this activity). Within the selected product headings the observation unit selects specific representative products according to specified criteria.	
PT	Products are selected in order of importance of sales in order to achieve 70% of total industrial sales.	Annual Prodcom survey
RO	The largest products in turnover terms are selected in each activity, such that the selected products represent at least 60% of sold production.	
SI	From each class of NACE Rev. 1.1 the products with the biggest turnover on the domestic market are selected. A judicious selection of products is agreed with each observation unit. Where it is possible the selection of products is limited mainly to the products of mass production. During the year new and significant products and substitutional products are introduced by experts in the enterprises.	Sales value from the annual industry report using addition information from producers
SK	Within each stratum (4-digit and 6-digit of CPA), based on turnover, products are selected to reach 40 to 70% of turnover.	Observation units define representative products in a special 5-yearly survey for selecting representative products
FI	The selection of products is made on a judicious basis together with reporting units.	
SE	n/a	Results of the Prodcom survey
UK	PPS	The annual Prodcom survey
NO	A judicious selection of products is agreed with each observation unit.	
CH	Specific products are selected by the observation unit.	
HR	A cut-off sample of the largest products is selected within each CPA stratum.	
TR	A cut-off sample of the largest products is selected within each CPA stratum.	Annual industrial production survey

Source: PEEI in focus (2007)

Level of detail of products

	Level of detail (references to Prodcom list or CPA may in fact be national variants)
BG	More detailed level than 9 digit level of CPA/Prodcom list
CZ	domestic: 9 digit level of CPA/Prodcom list; non-domestic: 8 digit level of CN, 3 digit level of CPA/NACE and 2 digit level of SITC
DK	HS-level
DE	9 digit level of national CPA/Prodcom list, some additional 10 digit level
ES	9 digit level of CPA/Prodcom list
FR	4 digit level of CPA/Prodcom list and finer detail of national classification
IT	9 digit level of CPA/Prodcom list
LT	10 digit level of national classification version of Prodcom
HU	6 digit level of CPA/Prodcom list
NL	4 digit level of CPA/Prodcom list (some cases lower level)
AT	10 digit level of Prodcom
PL	6 digit level of CPA/Prodcom list
SI	9 digit level of CPA/Prodcom list - NIP – National Nomenclature of Industrial Products
FI	6 digit level of CPA/Prodcom list
SE	8-digit level of CN/Prodcom
UK	6 digit level of CPA/Prodcom list
TR	9 digit level of CPA/Prodcom list

Source: PPI task force

Number of selected products and average number per observation unit

	Number of products in sample						Average number of products/price quotes each observation unit asked to provide					
	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy	Total industry	Intermediate goods	Capital goods	Consumer durables	Consumer non-durables	Energy
BE	1 563	718	218	130	481	16	1.4	1.4	1.1	1.5	1.5	2.3
BG	1 078	472	215	40	319	32	4.8	5.1	4.0	3.3	5.3	4.9
CZ	4 713	2 046	829	245	1 409	184	:	:	:	:	:	:
DK	1 791	649	458	168	500	16	2.4	2.4	2.5	2.5	2.4	1.6
DE (1)	15 266	5 433	4 110	710	2 618	2 385	2.1	1.8	2.3	1.7	2.0	3.9
EE	540	:	:	:	:	:	1.8	:	:	:	:	:
IE	:	:	:	:	:	:	:	:	:	:	:	:
EL (2)	3 100	633	503	92	1 839	74	2.5	1.7	2.4	1.8	2.7	2.0
ES	1 450	661	220	77	459	34	3.0	3.0	2.0	3.0	4.0	7.0
FR	15 000	6 855	1 877	736	4 882	650	4.0	:	:	:	:	:
IT	1 102	446	234	81	297	44	:	:	:	:	:	:
CY	1 076	370	134	94	465	13	3.8	3.8	3.5	4.1	4.0	3.3
LV	1 261	:	:	:	:	:	3.0	:	:	:	:	:
LT	886	264	42	40	423	117	2.7	2.3	2.0	2.9	3.3	2.3
LU	906	429	211	2	243	21	7.4	7.2	7.5	2.0	9.7	2.6
HU	5 826	2 361	510	297	2 169	489	4.6	4.3	3.8	4.5	5.0	6.2
NL	9 700	:	:	:	:	:	3.5	:	:	:	:	:
AT (3)	~3 300	:	:	:	:	:	2 to 3	:	:	:	:	:
PL	19 000	:	:	:	:	:	5 to 6	:	:	:	:	:
PT	16 532	:	:	:	:	:	5.1	:	:	:	:	:
RO	1 736	822	328	90	414	82	:	:	:	:	:	:
SI	1 846	788	146	62	597	253	6.0	:	:	:	:	:
SK	3 735	1 508	448	130	1 424	225	6.0	5.0	4.0	4.0	8.0	6.0
FI	651	275	108	40	205	23	1.5	1.5	1.3	1.4	1.7	1.4
SE	:	:	:	:	:	:	:	:	:	:	:	:
UK	7 280	2 875	1 445	380	2 525	55	1.7	1.6	1.5	1.3	1.9	11.0
CH	850	:	:	:	:	:	7.0	:	:	:	:	:
HR	420	:	:	:	:	:	:	:	:	:	:	:
TR (4)	4 034	:	:	:	:	:	2.8	:	:	:	:	:

When the information provided concerns the number of price quotes this is shown with a light grey background. When the information provided concerns the number of product headings/categories this is shown with a dark grey background.

(1) Prices are observed for a total of about 1 600 product headings.
(2) Prices are observed for a total of 419 product headings.
(3) Prices are observed for a total of 1 000 product headings (ÖPRODCOM 10-digit).
(4) Prices are observed for a total of 653 products.

Source: PEEI in focus (2007)

Frequency of updating sample

A total of 12 countries reported that they update the sample of observation units every five years; three of these indicated that minor changes are made more frequently. Three countries indicate that they continuously update the sample - this may be monthly or annually. The remainder generally update every year or every two years.

Updating the selection of products generally has the same rhythm as the selection of observation units, with only Luxembourg noting a major difference.

Frequency of updating selection of observation units and products

	Sample of observation units	Sample of products
BE	Approximately every two years	Approximately every two years
BG	In principle 5 yearly; if a significant enterprise appears on the market it is included in the survey	In principle 5 yearly; if an enterprise that is already included in the sample starts production of products from an important PRODCOM group its specifications are included in the survey
CZ	Continuously	Continuously, as necessary; a fundamental revision is carried out every five years
DK	Continuously	Continuously
DE	A fundamental revision of the sample is carried out every 5 years in connection with re-basing procedures. However, the samples are subject to permanent adjustments due to necessity of replacements forced by changes in the market structures	A fundamental revision of the sample is carried out every 5 years in connection with re-basing procedures. However, the samples are subject to permanent adjustments due to necessity of replacements forced by changes in the market structures
EE	Annually	Annually
IE	n/a	n/a
EL	5 yearly	5 yearly
ES	5 yearly; minor changes are made yearly	5 yearly
FR	5 yearly	5 yearly
IT	5 yearly	5 yearly
CY	5 yearly	5 yearly
LV	Annually	Annually
LT	Annually	Annually
LU	5 yearly	Continuously, as necessary
HU	Updated annually	Updated annually
NL	5 yearly, with the base year change	5 yearly, with the base year change
AT	Annually	Annually
PL	Annually, at the beginning of the year; monthly verification	Annually, at the beginning of the year; monthly verification
PT	5 yearly	5 yearly
RO	Annually	Annually
SI	Annually	Annually
SK	Continuously	Updating of products at 4-digit CPA level is carried out continuously; updating of representatives with individual observation units is done every 5 years
FI	5 yearly	5 yearly
SE	Annually (one fifth reviewed each year)	Annually (one fifth reviewed each year)
UK	Annually	Annually
NO	2 yearly	2 yearly
CH	When required	When required
HR	Partly annually	Partly annually
TR	Annually	Annually

Source: PEEI in focus (2007)

Practical example, Denmark

The example below, focusing on the sampling maintenance issue, is an extract from a paper on sampling design prepared by Statistics Denmark.

As time passes, both sampled units and representative products disappear; it is therefore necessary to update the sample on a regular basis. If a unit stops reporting for a particular representative (deletes it) without replacing it, that unit will receive a standard letter asking for a replacement. However this procedure is not enough to keep the sample updated. Therefore Statistics Denmark has developed a computer system to supervise and manage sample maintenance – the S&P system; elementary indices for industrial services are not supervised by this system but are supervised by other procedures. The system contains the following information:

Contents of the S&P system

The population	Import (business register number, HS , year, month, country and value); export (business register number, HS, year, month, country and value); production (business register number, HS, year, quarter and value)
The sample	The PPI sample (business register number, HS, etc.)
Business register information	Business register number, name and address, NACE, number of employees and so on
Bad experience information	Business register number and HS
Sample quality requirements	For each HS a minimum number of units and prices

Once a year, the S&P-system is updated on-line with information from the foreign trade statistics, the industrial production statistics (Prodcom) and the central business register. Quality requirements are normally adjusted once a year and bad experience information about unsuccessful requests to units are regularly updated.

When this information becomes available in the computer system, the system can:

- find elementary aggregates (in this case at a detailed level of the HS) in the sample where quality requirements are not met and find the same HS in the population;
- select top-down by turnover those units which are not already in the PPI sample and for which no bad experience has been recorded;
- print a letter to the unit and ask for selection of representative products.

Statistics Denmark uses a semi-automatic system, where the computer suggests units which are selected by the staff working on the PPI. The system can manage requests and reminders. Normally a large number of letters are sent to units at the same time.

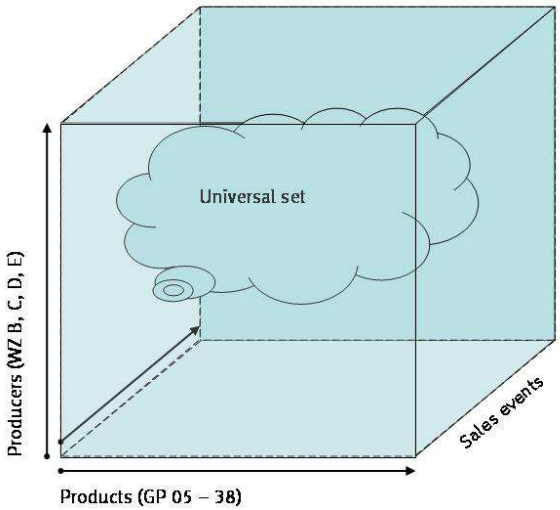
When resources are available, the member of staff working on the PPI send a letter to all units and asks them to check whether the selected representative products are still appropriate and if this is not the case to replace them with others.

The legal authority to collect price information from units is provided by the Act on Statistics Denmark. If a unit refuses, without good reason, to select representative products the police are asked to start legal proceedings against the unit. If the unit does not have products that are suitable for price statistics like unique products, the request is dropped.

Practical example, Germany

For German domestic producer prices of industrial products the universe is comprised of the prices of all sales events in the period of observation carried out by units resident in Germany towards domestic customers. The product classification used is the Güterverzeichnis für Produktionsstatistiken (GP) while the activity classification is the Klassifikation der Wirtschaftszweige (WZ).

Universal set of producer price statistics



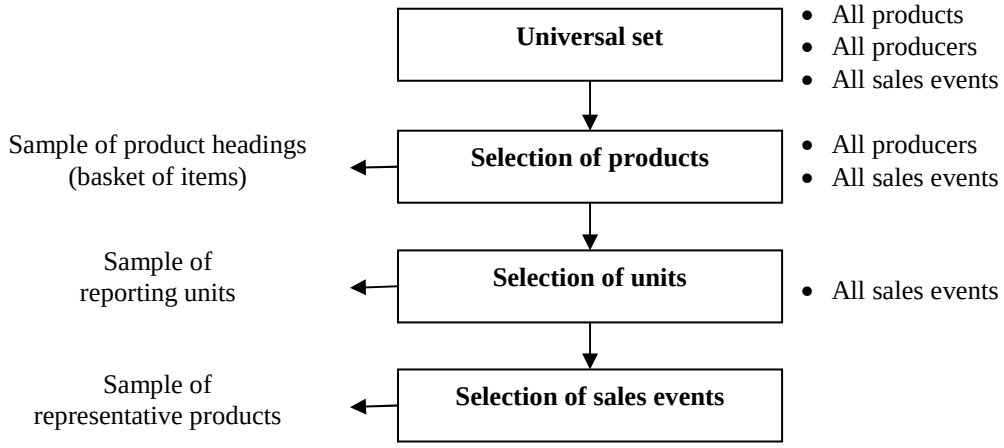
Statistical recording of the entirety of the prices of these sales events is not regarded as feasible and the exact composition of the universal set is not known: traditional sampling procedures (random or stratified random sample) cannot be used. A combination of targeted selection and cut-off procedures is applied in German producer price statistics. This method consists of three steps.

The first step involves the selection of products (product headings) with a relatively high significance based on the share of production value attributed to each of the product headings; the selected product headings form the basket of items.

The second step then involves the selection of units which produce and sell the products in the basket; these are then the sample of reporting units.

In the third step, the specific sales events (transactions) are determined by the selected reporting units; these form the basis for the monthly price observation and are referred to as representative products (or simply representatives).

Selection steps in taking the sample



The main goal in forming the samples is to attain as high a degree of representativeness as possible. In addition, care should be taken that the effort involved for the reporting units is kept as low as possible and that the reports are used efficiently for the calculation of the index. A more detailed description of each of the steps is provided below.

Selection of the basket

Initial selection of product (headings)

The production statistics form the essential basis for the compilation of the basket of items.

Each product heading at the 9-digit level is assigned an initial share (a weight) that corresponds to its share in total sales. The result is a list of all product headings at the 9-digit level, their sales values and their share in the total sales. The product headings to be included in the basket then have to be selected from this list. The basket is composed of the selection of product headings whose price development is to be observed representatively for all domestic products. Consequently, price surveys are conducted and elementary indices are calculated only for product headings represented in the basket.

The table below shows an example of the list of product headings within just one 4-digit activity – Class 10.81. For each product heading the table shows the value of domestic sales from the year 2005 and its share.

From these data, the product headings with high sales values are selected for each Class. To make the selection, all product headings within a Class are sorted in descending order by their shares; the largest are selected for inclusion in the sample such that their cumulative share of sales within the Class reaches 60 % of the domestic sales within that Class. In certain cases, several product headings (at the 9-digit level) may be combined to form one basket item. This is frequently the case where only minimal weights were determined for the individual product headings and none of them individually would have a high sales significance of its own, but the share in the total turnover is significant as a combined basket item. The result of the selection procedure is a list of product headings which correspond to individual 9-digit codes or combinations of 9-digit codes. The right-hand column shows the product headings that were selected to be in the basket for 2005 within the Class 10.81.

Example of a product sample

Sales statistics				
WZ code	**Label**	**Turnover, 2005 (EUR thousand)**	**Weighting share (per mil)**	
10.81	Sugar	2 322 063	2.55	
Production statistics				
GP code	**Label**	**Turnover**	**Initial share**	**Basket of goods, 2005**
108111000	Raw cane or beet sugar, in solid form, not containing added flavouring	130 787	0.14	
108112300	White sugar from cane or beet sugar, in solid form, not containing added flavouring	2 002 964	2.20	X
108112900	Other refined cane or beet sugar and chemically pure sucrose	18 657	0.02	
108113300	Raw cane or beet sugar, containing added flavouring or colouring matter	20 692	0.02	
108114300	Molasses and other waste of cane sugar manufacture	3 103	0.00	
108114500	Molasses and other waste of beet sugar manufacture	41 806	0.05	
108120000	Beet-pulp, bagasse and the like	104 054	0.12	X
Total		**2 322 063**	**2.55**	

The list of selected product headings is coordinated with the major data users, in particular with the specialist trade associations. This allows additional wishes of various groups of users to be taken into consideration. Some trade associations, for example, require information on the price development in specific product headings, although the sales value would actually be too low to justify inclusion in the basket. It is conceivable that with some product headings a more detailed classification below the level of 9-digit GP codes is desired. The special wishes of the users of the statistics are considered as far as possible in compiling the basket.

Assignment of weights

The overall coverage of domestic sales attained by the product headings in the basket (which will therefore be surveyed) is about 75 %. This means that some product headings (around 25 % in sales value terms) are not represented directly by a basket item and no prices are collected for them. Nevertheless the price development of the product headings contained in the basket is considered to represent all product headings, including those that have not been selected. The sales shares of the product headings that are not contained in the basket are assigned to product headings within the basket: as a result the weights of the product headings in the basket cover the entire domestic sales. If, for instance, only a single product heading from a given product category (at the 6-digit level) is included in the basket, the price development of this product heading is deemed to be representative of the entire category. The selected product heading is assigned the entire weight of the product category (at the 6-digit level) as the total of the weights of the sub-indices must always be equal to the weight of the index at the next higher level. Where several product headings are contained in the sample the initial shares of the excluded product headings are reassigned to the selected products: the assignment of these shares to products in the basket is based primarily on the code or otherwise proportionally to the weights of the basket items.

The example in the table below shows that the initial share of the product headings which were not selected for inclusion in the basket were distributed proportionally to other product headings within the same Class that were selected for inclusion in the basket. In the example, the three product headings with the highest initial share in the overall sales are included in the basket. The shares of the other product headings are reassigned proportionally to the selected product headings: in this particular example the result is that most of the reassigned share is assigned to the weight of a single selected product heading while the selected product heading with the lowest initial share is not assigned a higher weight.

Proportional assignment of the weights to the basket items of the 4-digit code (example)

Sales statistics				
WZ code	**Label**	**Turnover, 2005 (EUR thousand)**	**Weighting share (per mil)**	
10.81	Sugar	2 322 063	2.55	
Production statistics				
GP code	**Label**	**Initial share**	**Basket of goods, 2005**	**Weight (per mil)**
108111000	Raw cane or beet sugar, in solid form, not containing added flavouring	0.14	X	0.15
108112300	White sugar from cane or beet sugar, in solid form, not containing added flavouring	2.20	X	2.28
108112900	Other refined cane or beet sugar and chemically pure sucrose	0.02		
108113300	Raw cane or beet sugar, containing added flavouring or colouring matter	0.02		
108114300	Molasses and other waste of cane sugar manufacture	0.00		
108114500	Molasses and other waste of beet sugar manufacture	0.05		
108120000	Beet-pulp, bagasse and the like	0.12	X	0.12
Total		**2.55**		2.55

Once the basket items have been selected a revision of the fine weighting is carried out. As the reassignment of shares from non-selected product headings has resulted in a new set of weights for the selected product headings, it is necessary to investigate which product headings in the basket (and their weights) must be kept confidential in cases when the weight or price indices could provide indications as to the sales or price development in individual enterprises.

The following table is an excerpt from the final weighting scheme for 2005, showing information for Class 10.71 (bread, pastry goods and cakes). The weight of Class 10.71 was subdivided into two product headings (at the 9-digit level). Fresh bread and rolls (10 71 11 000) is furthermore specially characterised by usage of a more detailed classification than prescribed by the product classification.

Excerpt from the weighting scheme for the domestic PPI, 2005

Code	Label	Weighting share in the overall index (per mil)
10 to 33	Products of manufacturing	770.73
10	Food products and beverages	92.35
107	Bakery and farinaceous products	14.51
1071	Bread; manufacture of fresh pastry goods and cakes	11.04
1071 1	Bread; manufacture of fresh pastry goods and cakes	11.04
1071 11	Fresh bread and rolls and similar products, without honey, eggs, cheese, or fruit	7.34
1071 11 000	Fresh bread and rolls	7.34
	White bread (without bread for toasting)	0.51
	Bread for toasting	0.54
	Rye and mixed wheat and rye bread (without whole-grain or wholemeal bread)	1.66
	Whole-grain and wholemeal bread	0.97
	Rolls	3.66
1071 12	Fine bread, cake and pastries (without long-life products)	3.70
1071 12 000	Fine bread, cake and pastries (without long-life products), sweetened also deep-frozen	3.70

Selection of the units

Once the product headings to be included in the basket have been determined and weights have been assigned to them, the selection of reporting units is made. The sample of reporting units is formed by using a combined method of a cut-off procedure and targeted selection.

The production statistics also serve as a data source for the formation of the sample of reporting units. An evaluation is carried out of the individual datasets of the production statistics which contain for each product the contact details of the individual producers and the corresponding production values. For enterprises classified to energy and water supply, the Federal Statistical Office does not have detailed data at its disposal. To obtain more detailed data to select reporting units, information provided by the appropriate trade associations is evaluated. The sub-division of the market in these activities is clearly structured. In the activities of electricity production and distribution, gas distribution and water supply and distribution, close collaboration with the associations enables a breakdown of the weighting of the individual basket items to be linked to the reporting units.

The first step for the selection of the reporting units is to determine the number of reporting units for each item in the basket. The exact number of reporting units is determined manually for each basket item.

- A basic rule is that at least one price series is necessary and consequently at least one reporting unit must be selected per 0.1 ‰ (per mil) weighting share.
- Furthermore the price development of the item in the past is evaluated to see whether it exhibited strong dispersion in the past, in other words the volatility of price developments is considered. Where high dispersion can be seen a larger number of price series is useful.
- In some economic activities, only a small number of units operate due to the market structures, an example being steel production. This activity is dominated by several large units alongside which only a few small units operate (with small market shares). The 0.1 ‰ rule is not followed in these cases, and for instance price surveys are conducted with all units.

The next step is to select the reporting units and this is done based on the production value for the selected product headings. Note that in Germany the production statistics exclude enterprises with fewer than 20 persons employed and so only enterprises with a certain minimum size can be included in the sample. Since a greater fluctuation in small units may be expected this cut-off method is applied when compiling the sample. A unit which is below the cut-off limit may be less able to submit comparable price reports on a consistent basis for a long period than units above the cut-off limit.

For each item in the basket the production value for each unit is sorted from largest to smallest and then the selection is made using a top-down approach. The selection is made manually for each basket item,

partially also taking regional aspects into consideration. All in all, the cumulated production value of the selected units should cover a high a percentage of the total sales of each item in the basket; the final coverage will vary depending on the degree of concentration for each basket item. The table below shows an example of the selection of units.

Example selection of the units

White sugar from cane or beet sugar, in solid form, not containing added flavouring (GP code 10 81 12 300); weighting share = 2.55 ‰

Unit number	Production value (EUR)	Selection	Coverage (%)	Cumulated coverage (based on data before rounding) (%)
1	199 009 430	X	8.18	8.18
2	154 678 404	X	6.36	14.55
3	146 053 936	X	6.01	20.55
4	139 412 590	X	5.73	26.28
5	132 599 966	X	5.45	31.74
6	129 336 130	X	5.32	37.06
7	128 386 493	X	5.28	42.34
8	108 990 741	X	4.48	46.82
9	107 779 530	X	4.43	51.25
10	106 837 545	X	4.39	55.64
11	106 115 560	X	4.36	60.01
12	97 837 810	X	4.02	64.03
13	95 114 080	X	3.91	67.94
14	91 766 132	X	3.77	71.72
15	81 582 025	X	3.35	75.07
16	80 332 564	X	3.30	78.38
17	75 187 336	X	3.09	81.47
18	73 197 038	X	3.01	84.48
19	65 056 487	X	2.68	87.15
20	63 597 507	X	2.62	89.77
21	57 418 464	X	2.36	92.13
22	56 997 047	X	2.34	94.47
23	48 543 834	X	2.00	96.47
24	46 201 848			
25	35 741 851			
26	3 883 320			
Total	2 431 657 668			

At the same time that the selection of units is made the total number of price reports to be submitted by a unit is investigated. Particularly where large reporting units are concerned, it frequently happens that these have been selected for several items in the basket or are requested to submit several price reports for a single item in the basket. In this case the burden on the units has to be evaluated. The goal is to strike an appropriate balance between the number of units and the number of price reports per unit.

Since the selection constitutes a targeted sample, no statements can be made as to sampling-related survey errors. Units with major market significance are selected. As most markets are characterised by extensive transparency and free competition, a targeted sample provides representative price data as a rule. Changes usually concern the entire production activity regardless of the units, so that the individual units within a market usually show similar price developments.

Updating the sample of units

A fundamentally new selection of the sample of units only takes place in the context of rebasing. At this time the new and previous samples are compared and newly-selected units are contacted.

Selection of the transactions

The final step is the selection of transactions (sales events) by the reporting units.

A transaction comprises a precise product specification and sales conditions. The selection of these transactions is made by the reporting unit. Each transaction is identified by a unique 11-digit processing

number. This number consists of the nine digits of the product heading in the basket and an additional two-digit consecutive number.

When the reporting units make their selection of transactions, they must observe certain criteria. First of all, the formal guidelines must be complied with.

- Clearly the representative product must correspond to the product heading in the product classification. The unit uses the description of the 9-digit code of the product heading in the basket to identify a representative product from its product range which then has to be precisely specified.
- In addition, the representative product should have a major and stable sales significance within the enterprise; this is to ensure that it is on the market for a longer period and its price development corresponds to the general market conditions of this type of product.
- The price development of the selected representative product should be representative of similar versions of the product not included in the price observation: the aim is for the selected representative product to represent all products produced in the reporting unit that are classified to the same 9-digit GP code.

Once the reporting unit has opted for a representative product, this is followed by establishing a precise description including information on the product definition and the sales conditions. The combination of representative product description and sales conditions constitutes the so-called price-determining characteristics of the transaction, to which the reported price will apply.

Dealing with changes in the selections

The German producer price statistics are based on a Laspeyres index concept (rebased every five years); the Laspeyres concept requires a constant sample and set of weights. However, this is not feasible in practice as changes take place during the five-year term of a base period so that the originally-defined basis of the calculation has to be adjusted. Although the basket of product headings and the associated weighting system are not changed during this period ongoing corrections are made as regards the composition of the sample of reporting units and the selection of representative products. Although these corrections are not in line with the Laspeyres concept they permit a consistently high level of representativeness in the index calculations to be achieved.

Changes may occur for various reasons within the sample of reporting units. Firstly, the loss of a complete reporting unit is possible. In this case it is no longer possible to receive price reports. Consequently, a replacement is identified using the most recent individual data available in the production statistics. Secondly, in an annual review of the samples, individual reporting units are deliberately exchanged, especially in markets undergoing rapid structural change so that the new market situation can be observed.

Frequent changes are seen with the transactions as well. Due to market flexibility and as a reaction to changing demand, new products may be launched whose significance increases rapidly. New technologies and production possibilities also influence this trend. If the market significance of a new product (its sales) increases rapidly it should be considered in the index. In the context of the regular price survey, the relevance of the selected representative products should be verified by the reporting units on an ongoing basis, in accordance with the survey guidelines: the reporting units are expressly requested to do this in letters regularly addressed to them. An exchange of the representative products can be either enforced when a representative product is no longer available or implemented deliberately. If the old representative product is no longer produced or has lost its market significance, replacement becomes imperative. In this case, if possible, a replacement should be found in the same reporting unit. Special care must be taken here to ensure that the new representative product is classified within the same 9-digit code of the product heading in the basket. In contrast to enforced replacements, deliberate replacements take place when a new product has gained significance as a follow-up product or a new model and it makes sense to carry out an exchange.

The stability of the samples varies widely among different types of products. Whilst raw materials in particular, as well as semi-finished goods and some finished goods with a low innovation potential, are relatively stable, goods characterised by rapid technological progress require more frequent adjustments.

Recommendations

Overview of the main IMF recommendations

The IMF manual on PPIs dedicates chapter 5 to sampling issues in price collection. The chapter contains a detailed description of the common problems and of the different sampling strategies one may consider in price survey sampling.

A summary of the IMF recommendations is presented below (see IMF manual on PPIs, Chapter 5, section G):

> (i) Determine the survey objectives, uses, coverage, and resources before determining the data to be collected, the periodicity of collection, and the type of sampling that will be employed.
>
> (ii) Identify sources to use to develop a sampling frame for selecting the establishments and products for covered sectors and industries.
>
> (iii) Use probability sampling techniques to the extent possible.
>
> (iv) To make the sample more efficient, use multiple levels of stratification within the sample design.
>
> (v) The price sample should be based on actual transactions with the characteristics of those transactions fully described.
>
> (vi) Initial recruitment of establishments should be completed by personal visits.
>
> (vii) Samples of establishments and products must be maintained so the reliability of the PPI remains intact. A program of sample maintenance is needed for this purpose, and sample rotation also may be desirable.

Chapter 8 of the IMF manual on PPIs describes in detail the issue of the sample maintenance, namely the treatment of the appearance and disappearance of units and products. An extract from this chapter is presented below.

> 8.38 … In this section some of the more important issues are reiterated.

- Where nothing much in the quality and range of available goods changes, there is much that is advantageous to the use of the matched models methods. It compares like with like from like establishments.
- Statistical metadata systems are needed for quality adjustment issues to help identify the industries in which matching provides few problems. This focuses attention on those that are problematic by collecting and providing information that will facilitate quality adjustment. It also allows for transparency in methods and facilitates retraining.
- Where there is a very rapid turnover in items, such that serious sample depletion takes place quickly, replacements cannot be relied on to replete the sample. Alternative mechanisms, which sample from or use the double universe of items in each period, are required. These include chained formulations and hedonic indices as discussed in Chapter 7, Section G.
- Some new goods can be treated as evolutionary and incorporated using non-comparable replacements with an associated quality adjustment. The timing of the replacement is critical for both the efficacy of the quality adjustment and the representativeness of the index.
- Instructions to reporting units on the selection of replacement items are important because they also have a bearing on the representativeness of the index. The replacement of obsolete items with newly introduced items leads to difficulties in undertaking quality adjustments, while their replacement with similar items leads to problems of representativeness.

- Sample rotation is an extreme form of the use of replacements and is one mechanism for refreshing the sample and increasing its representativeness. However, a disadvantage is the possible bias arising from the implicit assumptions underlying the quality adjustment overlap procedure not being met.
- Revolutionary goods may require the augmentation of the sample to make room for new price series and new weighting procedures. The classification of new goods into evolutionary goods and revolutionary goods has a bearing on the strategy for their introduction, directed replacement (substitution), and sample augmentation.

8.39 … The rate of change is rapid in many industries. With this in mind, sampling for price change estimation is a dynamic rather than static problem. Somehow, the prices of new products and in new establishments have to be compared with old ones. It is important to realize that whatever methods and procedures are used in a price index to handle these dynamic changes, the effects of these procedures will always amount to an explicit or implicit estimation approach for this dynamic universe.

Representation of change in a price index

8.40 From a sample selection perspective, there are three ways of handling dynamic changes in an elementary aggregate universe, where varieties and establishments move in and out:

- by resampling the whole elementary aggregate at certain points in time,
- by a one-to-one replacement of one variety or establishment for another one, and
- by adding and deleting single observation points (items in establishments) within an index link.

Resampling

8.41 In resampling, the old sample is reconsidered as a whole so as to make it representative of the universe in a later period. This does not necessarily mean that all, or even most, sampling units have to be changed, only that a fresh look is taken at the representativeness of the whole sample and changes undertaken as appropriate. The methods used for resampling could be any of those used for the initial sampling. In the case of probability sampling, it means that every unit belonging to the universe in the later period needs to have a nonzero probability equal to its relative market share of being included in the sample.

8.42 Resampling or sample rotation is traditionally combined with the overlap method outlined in Chapter 7, Section D. It is similar to the procedure used when combining two links in chained indices. The first period for which the new sample is used is also the last period for which the old sample is used. Thereby, price change estimation is always based on one sample only—the old sample up to the overlap period and the new sample from the overlap period onward, as discussed in further detail below.

Resampling is the only method that is fully able to maintain the representativeness of the sample and, resources permitting, should be undertaken frequently. The necessary frequency depends on the rate of change in a particular product group. It relies, however, on the assumption that the price differences between the old and new items are appropriate estimates of quality differences. At its extreme, resampling amounts to drawing a new sample in each period and comparing the average price between the samples, instead of the usual procedure of averaging price changes for matched samples.

Although being the logical end-point from a representativeness point of view, resampling each period would aggravate the quality adjustment problem by its implicit quality adjustment procedure, and, thus, it is not recommended.

Replacement

8.43 A replacement can be defined as an individual successor to a sampled product that either disappeared completely from the market or lost market share in the market as a

whole or a specific establishment. Criteria for selecting replacements may differ considerably. There is first the question of when to replace. Usual practices are to do it either when an item disappears completely or when its share of the sales is reduced significantly. Another possible, but less-used, rule would be to replace an item when another variety within the same group, or representative item definition, has become larger with regard to sales, even if the old variety still is sold in significant quantities.

8.44 Second is the question of how to select the replacement item. If the rule for initial selection was most sold or with probability proportionate to (sales) size, then the replacement rule could follow the same selection rule. Alternatively, the replacement could be that item that is most like the old one. The advantage of the former rule is better representativeness.

The advantage of the most-like rule is, at least superficially, that it might result in a smaller quality adjustment problem.

8.45 It is important to realize that, at least with today's practices, replacements cannot adequately represent new items coming into the market. This is because what triggers a replacement is not the appearance of something new but the disappearance or reduced importance of something old. If the range of varieties in a certain group is increasing, sampling can represent this increase only directly from the set of new varieties, such as in the case of resampling.

Adding and deleting

8.46 It is possible to add a new observation point into an elementary aggregate within an index link. If, for example, a new brand or model of a durable was introduced without replacing any particular old model, it would be desirable to add it to the sample starting from the time of its introduction. In order to accommodate this new observation into the index system, its reference price needs to be imputed. A practical way to do this is to divide its price in the month of introduction by the price index of all other items in the elementary aggregate from the reference period to the month of introduction.

In this way, its effect on the index for months up to the introduction month will be neutral.

8.47 Similarly, an item that disappears could just be deleted from the sample without replacement.

Price change can then be computed over the remaining items. If no further action is taken, this means that the price change for the deleted item that was measured up to the month prior to deletion will be disregarded from the month of deletion. This may or may not be desirable, depending on the circumstances in the particular product group.

III

Data collection and processing

Chapter 3 Data collection and processing overview

Introduction

The previous chapter looked at the subject of including product headings in the basket, selecting units to be included in the survey, and specifying representative products to be observed over time as the basis for compiling the PPI. This chapter moves on from that preliminary stage and looks at the task of price collection and data editing which form the base on which the PPI is compiled. The processing of price data, including checking of the results, is presented more thoroughly.

It is important that collecting prices and processing the data is done well in order to have a good quality of price information to calculate reliable results. Depending on the specific circumstances in each country and its statistical traditions and customs different approaches are used to assemble the input for the index calculation.

Methods

Accounting conventions and frequency of data collection

Accounting conventions: reference date versus reference period

According to the Commission Regulation (EC) No 1503/2006 on definitions of the variables, the index should in principle reflect the average price during the reference period. In practice there are several different options for collecting a price observation for a given period, including: a specified reference date, a free choice of any reference date, an average price for the month supplied by the reporting unit, an average price for the month calculated by the statistical office based on price quotes for several dates during the period.

When a specific reference date is determined (typically the 15th of each month or nearest working day) reporting units should indicate the prices of their representative products referring to a contract that is concluded on that specified date or as near to that date as possible. The advantage of defining a certain reference date is its full comparability of the contracts over a longer period of time. Another advantage is that price quotes can be provided immediately after the specified date rather than waiting till the end of the month as is the case with averages and so the index can be compiled and disseminated earlier. One of the main disadvantages of a specified date is that price changes of volatile products that occur between different reference dates are not accounted for while calculating the index; another disadvantage is that price information may not be available for products that are rarely produced and so either a price on a date far away from the target date must be used or the missing price information replaced. For products with a significant impact on the national economy that are known to have, at least occasionally, a volatile price development, it is important that the index does indeed reflect average prices.

When no specific date is determined reporting units are often asked to give an average of comparable contracts concluded during the month relating to the representative product. The advantage of using average prices is that price changes that take place during the reporting month are included into the index. One of the disadvantages is that the method the reporting unit chooses to calculate this average price may not be known to the statistics office and therefore may differ between reporting units. It may be that unit values are calculated, defined as the total value of sales divided by the quantity that was sold, but unit values are intrinsically problematic because they do not consider changes over time i) in the quality of the representative product or sales conditions nor ii) in the composition of products of different quality (if the representative product is broadly defined).

Frequency of price observations

In general, prices are regularly collected from the sample of reporting units. As the producer price indices must be compiled with a monthly frequency, the prices should also normally be collected each month. For some representative products the prices do not change every month, for example prices for machinery may change only once a year. In these cases reporting units know long in advance when the next price adjustment will occur. To be released from the bureaucratic burden of providing monthly information the reporting unit might be given the opportunity to indicate the period of validity of the latest quoted price; the statistical office then collects the next price quote only when the end of the period of validity of the price has been reached. Equally some representative products may have stable prices such that a quarterly data collection may be adequate.

Exchange rates

The development of both domestic and non-domestic producer prices must be expressed in the currency of the country concerned. Generally this is straightforward for domestic prices where the prices are normally reported by reporting units in the currency in use in the country where they are resident. Prices quoted for non-domestic producer prices may reflect transactions made in another currency and this requires conversion. It is important which exchange rate is chosen to convert the non-domestic prices. The STS methodological manual says that the price index should measure the average price level during the reference month. However, in practice the information collected often refers to a particular day in the middle of the reference month, chosen as a representative date for the reference month.

Exchange rates can influence pricing strategies: the appreciation or depreciation of a currency can reduce or increase competitiveness and so producers may change prices in response to exchange rate movements. Measuring the impact of exchange rates on price changes is analytically interesting and such studies are normally conducted by central banks ([1]).

Data collection methods

When deciding on the ways to collect data three main aspects have to be considered. The first is security: because sales prices are often sensitive for reasons of competition it is important to find a genuinely secure way to transmit data from the reporting unit to the statistical office. The second aspect is cost: because prices are generally collected each and every month the collection should be not too cost-intensive, neither from the perspective of the statistical office nor the reporting unit. The third aspect is response burden for reporting units delivering price information over a long period of time: this should be kept as low as reasonably possible.

Each of the ways of data collection presented below requires a well designed questionnaire. When designing a questionnaire some aspects have to be thought about carefully.

- What information do reporting units need in order to provide the required data?
- How should the questionnaire be designed to make a reporting unit who is unfamiliar with statistics understand what is required (for example not only filling in the current price of a representative product but also give additional information on the change of quality, the reason for price changes, changes in product representativeness)?
- All contact information of the statistical office as well as the contact person in the reporting unit should be placed on the questionnaire in order to deal efficiently with questions on either side.
- Should reporting units be provided with the prices they delivered the previous month?
- The questionnaire should be structured such that completion of the questionnaire requires as little time as possible.
- The deadline for returning the completed form, regardless of the method, should be clearly visible for reporting units so as to reduce the risk of late answers.

([1]) As an example, see Filippo di Mauro, Rasmus Rüffer and Irina Bunda, *The changing role of the exchange rate in a globalized economy* (ECB, September 2008).

Paper questionnaire

Paper questionnaires may be used for collecting data by post or fax. There are two different kinds of questionnaires that can be used.

- The questionnaire is prefilled with the metadata describing the representative product(s) to be priced. Only the price(s) of the current month and in some cases of the previous month have to be added. Using this version the reporting unit will only get a minimum of paper to handle.
- A (shuttle) questionnaire is prefilled with the metadata describing the representative product(s) to be priced as well as previously provided prices that are available. After processing by the statistics office the questionnaire is returned to the reporting unit the following month to add the new price information. Proceeding in this way means that reporting units and staff in the statistical office have an overview of the previous developments of the prices.

In either case the reporting unit can be asked to give information on the reason(s) for uncommon price developments. When the specification of the representative product itself or of its sales conditions has changed the reporting unit should be asked to also change the description in the questionnaire.

Telephone questionnaire

A few countries also receive a considerable share of the monthly price quotes by telephone as they offer a special telephone data entry system to their reporting units. The description below is based on experiences in Sweden and the United Kingdom

When the data collection is done by phone a more automated method can be used. Touchtone data entry (TDE) is a technique using tone signals. When using TDE the reporting unit can report prices using the buttons on the phone. The reporting unit calls a phone number (in the United Kingdom this is a freephone number) and an answering machine requests the reporting unit to enter a unique identification number that was previously provided. When the code is entered the answering machine asks for a price for the representative products. The reporting unit has the possibility to report unchanged prices. With TDE a control system can be integrated: when prices are extreme or out of the interval of acceptance an audio comment is requested. The reporting unit may also be able to correct prices when they are entered incorrectly and then they may be contacted by the statistical office to investigate the circumstances.

Advantages:

- the method is relatively cheap;
- manual data entry is not necessary;
- it is possible to get long and exhaustive comments;
- micro validation in the first report stage.

Disadvantages:

- stimulus to report unchanged prices;
- Sweden experienced technical problems with several stages in the data process;
- time consuming for the reporting unit if they have many price observations to report.

Online (web) questionnaire

In many countries reporting units have the opportunity to send price information by online reports. Online reports may contribute to a reduction of costs and perceived burden for the reporting unit as well as for the statistical office. When the reporting units provide their prices online these may be transferred automatically for processing (without further data entry). One problem that has to be solved is to ensure the confidentiality of data that are sent via the web.

When using an online method the reporting units are normally reminded by e-mail rather than post when to submit the price quotes; this may be problematic when the e-mail is only addressed directly to the contact person in the reporting unit – if the contact person is, for whatever reason, not in the office the reminder may not reach anyone to undertake action.

As with touchtone data entry, a significant advantage of using online questionnaires is the possibility to integrate plausibility checks in the data collection stage.

E-mail questionnaire

Another form of electronic data collection is e-mail questionnaires. This may simply be an electronic version of the paper questionnaire or a specially designed questionnaire. As with the online (web) questionnaire, the main advantages are cost and burden reduction for both the reporting unit and the statistical office and more automated processing of the data. The disadvantages are also similar to those for online questionnaires, namely the risks involved with e-mail reminders and confidentiality of data. Furthermore, if the e-mail questionnaire requires the installation of an application on the reporting unit's computer system this might cause information technology (IT) problems with the reporting unit and the data may not be received or delivered correctly due to security constraints.

Other ways of data collection

Price information on some specific products in the sample may be collected by using other sources such as information from exchanges (for example for energy products) or publications of special products.

Information on the reason of price changes

There may be many different reasons for the most recent reported price for a representative product to be different from the previously reported one. For example this may reflect:

- a change in the cost of raw materials/intermediate products, of labour, or of other operating inputs;
- a change in taxes or charges,
- a general price change in that activity,
- the influence of a change in international/global prices,
- a change in customer and/or other sales conditions
- a change in the representative product itself.

As already noted, changes in the price index must not result from changes in quality – the index should represent pure price changes only without quality change. To be able to judge better the development of prices of certain products and to initiate quality adjustment if necessary the staff of the statistical office processing the data should know about the circumstances of price changes. A jump in prices of a certain representative product may be the beginning of a broader development but may also be the result of something specific to the reporting unit or an indication that there has been an undocumented quality change. For this reason it is very helpful for the statistical office to receive information on the reason for a change in prices.

While most countries ask reporting units for information about the reasons for price changes, only a few provide the reporting units with a list of potential reasons from which to select. The majority either use an open field on the questionnaire for comments or contact the reporting units (by phone) when processing the data in case of high price changes.

Processing of collected prices

Data collectors

The contribution of experienced and knowledgeable staff in the statistical office can increase the likelihood of reliable indicators being calculated. In many countries each data collector works on a

particular range of products or set of reporting units. By doing so it is possible for that person to build-up expertise which helps to make judgments on unusual or strong price developments.

Data entry

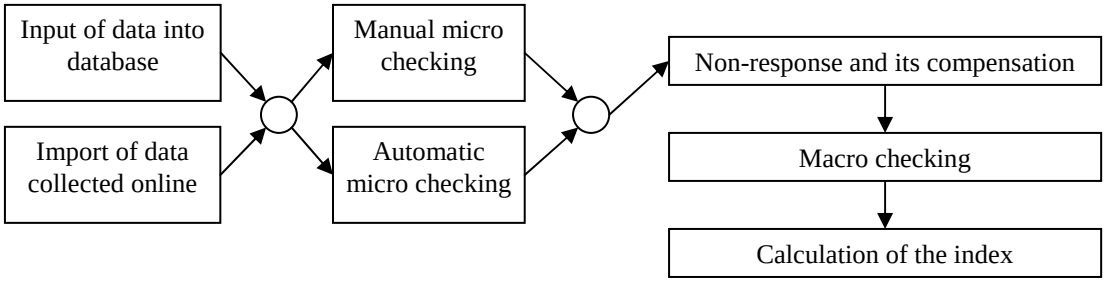
Price observations have to be entered into a database for further processing. In many countries the data from paper questionnaires have to be entered into the database, partly supported by data entry programmes which may show useful information already stored in the database to assist the data collectors to judge the price developments and which also perform some (semi) automated checks on the price series.

Data reported online are usually imported into the processing database having already been entered online and checked for plausibility at the time of data collection. This saves time for the data collectors, although these data may still require further plausibility checks.

Plausibility checks

There are different ways to check the plausibility of price observations and this partly depends on how the collected prices enter the statistical office. The different types of plausibility checks are presented below, independently of the data collection method.

Overview of processing stages



Errors can occur at any step of data processing. To minimise the impact most countries have developed data checking systems: these check the logic of reported prices. Considering the limited number of price quotes most countries receive, correction measures have to be taken because:

- unresolved price errors reduce the reliability of the index;
- simply filtering out erroneous price quotes and using an extrapolation method reduces the total number of price quotes, thereby negatively affecting the accuracy of the index due to the small sample size.

Various methods are used for checking. Few countries rely solely on manual checking of individual price quotes and most use computer assisted checking methods which involves using a program that identifies potential errors for individual price quotes or within a time series. This may be done while entering prices reported on a questionnaire, or while importing the reports from online or e-mail questionnaires, or as a batch process.

There are two kinds of potential errors: errors that must be corrected and potential errors that may be corrected or may in fact turn out not to be errors.

Computer assisted controls on micro data

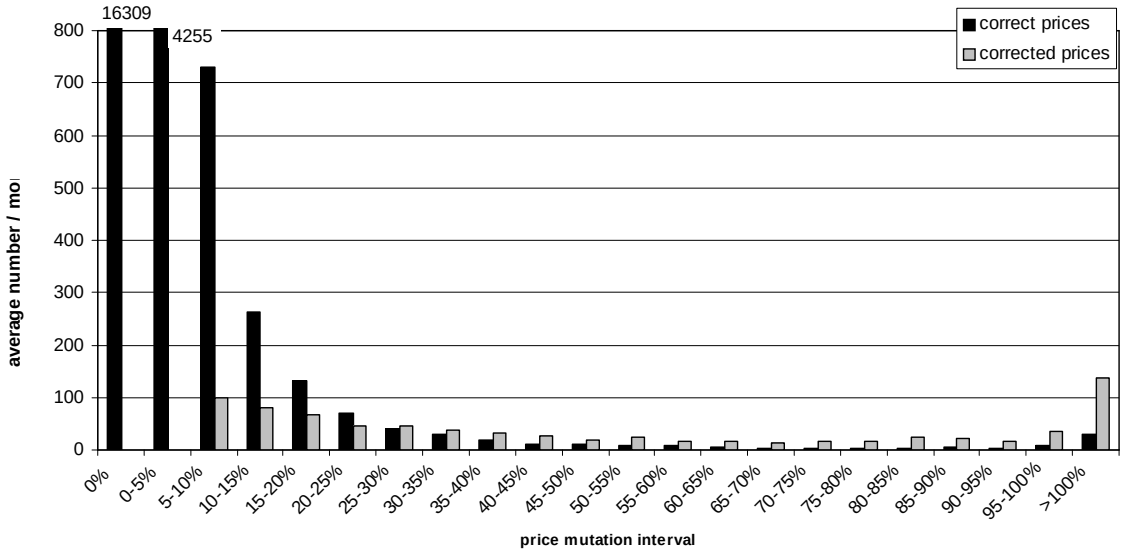
Threshold detection

Detection using thresholds identifies when prices have changed relative to the previous period by more than a pre-defined limit (the threshold). Either one threshold can be used for all products or different thresholds for different products to reflect differences in price volatility. Real errors that occur below the

thresholds are not identified by this method, so the judgement of data collectors can not be replaced by automatic checking, but the use of thresholds can facilitate this work.

The effectiveness of this technique may be compromised by setting the threshold too low, so identifying large numbers of possible errors. Research on the production database in the Netherlands shows that, in the period from 1 January 2000 to 1 December 2005 around 10 % of all price items (2 500 from 25 000) showed changes of 5 % or more. However, of these improbable price changes only about 1 000 were actually corrected after reporting units were consulted. Especially for price changes that were only slightly above the threshold the ratio between corrected and confirmed price changes was rather low – in other words relatively few prices that had been identified as possible errors were actually corrected after reporting units had been consulted. A summary of this analysis is provided in the figure below. The frequency diagram shows, for the indicated price change intervals (x-axis), the number of price quotes (y-axis): the grey bar shows the number of price quotes that fell into the indicated interval and were subsequently corrected while the black bar indicates those that were identified as possible errors but then confirmed as correct (as well as the number of price quotes that were assumed to be correct because they were below the threshold – these are shown in the two lowest intervals, below 5 %).

Number of price quotes analysed by the original price change (mutation) intervals, the Netherlands



Source: Statistics Netherlands

Prolonged period of absence of price change

If the price of a representative product remains the same for a long period it will, sooner or later, become necessary to contact the reporting unit in order to verify the information. It is possible that the reporting unit forgot to provide information about a price change (or quality change). The period of time a price might remain unchanged depends on the nature of the product, the economic cycle and may also vary between countries. If for example the price of a certain food product has not changed for a few months it is almost certain that there has been some kind of failure reporting the price quotes. On the other hand the prices of many other types of products can remain unchanged for a longer period of time, for example machinery.

Most countries check quotes when no price changes have been reported for a long period of time.

Absence of price change for certain important products

Some products exhibit very volatile prices, for example coke and refined petroleum products. They usually have different prices every month either lower or higher than before. If there is not any price change the reporting unit has to be contacted for confirmation.

Diverging developments within a reporting unit

It is not uncommon for reporting units to sell products on the domestic market and also abroad (non-domestic market). Some coherence in the price development on these two markets can be expected. Therefore, very diverging price developments within a reporting unit for the same representative product sold on these two markets may provide an indication of a need to contact the reporting unit. The price developments may still be correct, but an explanation of the reason for the different pricing strategies may help the validation of the data.

Suspicion of quotes based on unit values (average prices)

The unit value is defined as the quotient of the sales value and the sales quantity. Consequently, this price depends on the structure of the sales which may vary over time, resulting in a change in the unit value even when prices remain constant. For this reason, reporting of unit values should generally be avoided. In some countries the submission of unit values is agreed with reporting units under certain conditions. It is important in this regard for identical structures of sales to be used in the calculation of the unit values in consecutive periods. This means that in a given month a unit value should be compiled that is comparable to the unit value of the previous month, for example compiling unit values for both months using a common structure.

Manual controls on micro and macro data

Alongside computer assisted controls on the micro data, most countries also use manual controls to verify if the data are plausible, again using applications developed to increase productivity.

Cohesive micro checking

In order to identify (and then remove) errors in price quotes the data for several quotes can be checked in combination. For example, if one price quote within a product heading shows a totally different development from other price quotes in the same heading it may be necessary to investigate whether the atypical price quote is correct or not. Changes in individual price quotes may be outliers in terms of magnitude or direction. This type of checking can be best performed when all price quotes for a month are available.

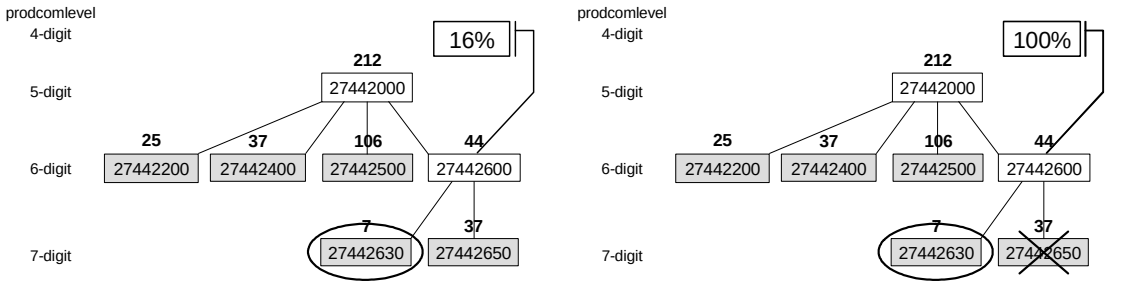
Top/down analysis

The explanation of this method is based on the experience in the Netherlands. With an in-house developed top/down tool (using Microsoft Access) the contribution of each individual product to the index development is determined. This tool enables PPI staff within the statistical office to focus quickly on questionable prices with the largest impact. Price items that strongly dominate the development of the index are checked for their plausibility, irrespective of their size of change. The influence of a price on a given aggregate of Prodcom headings is determined by the size of the price change, the weight of the reporting unit at the lowest level of aggregation and the aggregate weights.

If a perfect coverage of all detailed levels could be achieved the calculation of these influences would be straightforward. However, when there is (partial) non-response in the dataset, the importance (weight) of the price quotes that were collected increases. For instance, if a reporting unit provides only two instead of three price quotes for a particular Prodcom heading, each of these two price quotes determines half of the price development for the reporting unit, whereas this should be one third each. A similar situation occurs for higher aggregate levels, but then also the Prodcom heading weights are taken into account. When price quotes in two Prodcom headings are aggregated this is based on their price development and the relative weights of the headings. In the example shown below the contribution (based on weight) of Prodcom heading 27.44.26.3 to its aggregate level 27.44.26 (in the figure below database codes are

shown which were all given 8-digit codes, 0 being used to extend the length of the codes with 7 or less digits) is 16 % (7/44) when there are price observations in both neighbouring headings 27.44.26.3 and 27.44.26.5. However, when there is no price quoted for heading 27.44.26.5, then the influence within 27.44.26 of the neighbouring heading 27.44.26.3 suddenly grows to 100 % even though this Prodcom heading is less important than 27.44.26.5. The grey shaded Prodcom headings indicate elementary levels and the numbers above each box indicates their corresponding weight.

Contribution of Prodcom headings to aggregate levels



Assuming that there will always be some amount of (partial) non-response in a given dataset, this means that the influence of some individual price quotes on index development will be larger than expected on the basis of the weighting scheme alone. In the top/down analysis tool this has been taken into account and the adjusted (or 'real') contribution of price items to the index development at each aggregate level can be determined.

In a screen-shot of this tool below the contribution of all units to the index development of Division 19 (coke and refined petroleum products) is given. The reporting units (listed under bgvID on the right) are grouped into price change intervals (shown on the x-axis) while the height (indicated by the y-axis) of each bar gives an indication of the relative contribution of each item to the index change. In this example some units have a positive price change while others have a negative price change and so some bars are displayed upwards and some downwards. Summing the contributions of these price quotes results in the index change – in this case -0.93 index points.

The selected unit (identification (ID) number 22772) corresponding to the yellow bar has a strong negative influence on the index change, even though the absolute price change (between 0 % and 5 %) is not that large. In contrast, the purple bar on the far right of the graph has a price change of between 10 % and 15 %, but has a relatively smaller contribution to the index change. Other available options are, among others, analysis of more detailed aggregates (on the tabs), price status, price quote, absolute weight, relative weight and observation frequency.

Contribution of each price item to the absolute index change

In Spain a similar approach is used, where for PPI time series analysis, a graphical analysis of the impact of components on higher aggregates is available.

Validation by checking the macro data

Once the indices have been calculated a last check can be implemented into the processing procedure, namely to validate the results. Most countries only conduct a manual checking. This requires a competent knowledge of the market situation and development and hence has to be carried out by a particularly experienced member of staff. For products whose price developments are also examined at other economic stages comparisons can be made, for example comparing with the PPI on agricultural products or with the consumer price index (CPI) for consumer goods.

If the analysis of the macro data identifies errors the causes have to be investigated; if necessary micro level data may need to be corrected and validated again.

Methods applied in practice

Reference date

The following table summarises the practices concerning the use of prices for an individual date or for a whole month. In each country the practices are the same for the PPIs for both the domestic and non-domestic markets except in the Czech Republic and Germany.

Overview of the reference date/period

	PPI for domestic market	PPI for non-domestic market
BG	15th	15th
CZ	between 1st and 18th of the month	whole month
DK	15th	15th
DE	15th	whole month
ES	15th	15th
FR	whole month	whole month
IT	whole month	whole month
LT	15th	15th
HU	whole month	whole month
NL	whole month	whole month
AT	15th	15th
PL	whole month (average price)	whole month (average price)
SI	whole month	whole month
FI	whole month	whole month
SE	whole month	whole month
UK	whole month	
TR	average of 5th, 15th, 25th	

Source: PPI task force

Pre-notification of price quotes

Most of the countries listed in the following table allow reporting units to give a pre-notification of price quotes, sometimes in predetermined intervals of 3, 6 or 12 months. A longer period should not be accepted as sometimes a price might change unexpectedly.

Acceptance of pre-notification of price quotes

	Yes	No
BG		X
CZ	X	
DK		X
DE	X	
ES		X
FR	X	
IT		X
LT	X	
HU	X	
NL	X	
AT	X	
SI		X
FI	X	
SE	X	
UK	X	
TR	X	

Source: PPI task force

Data collection media

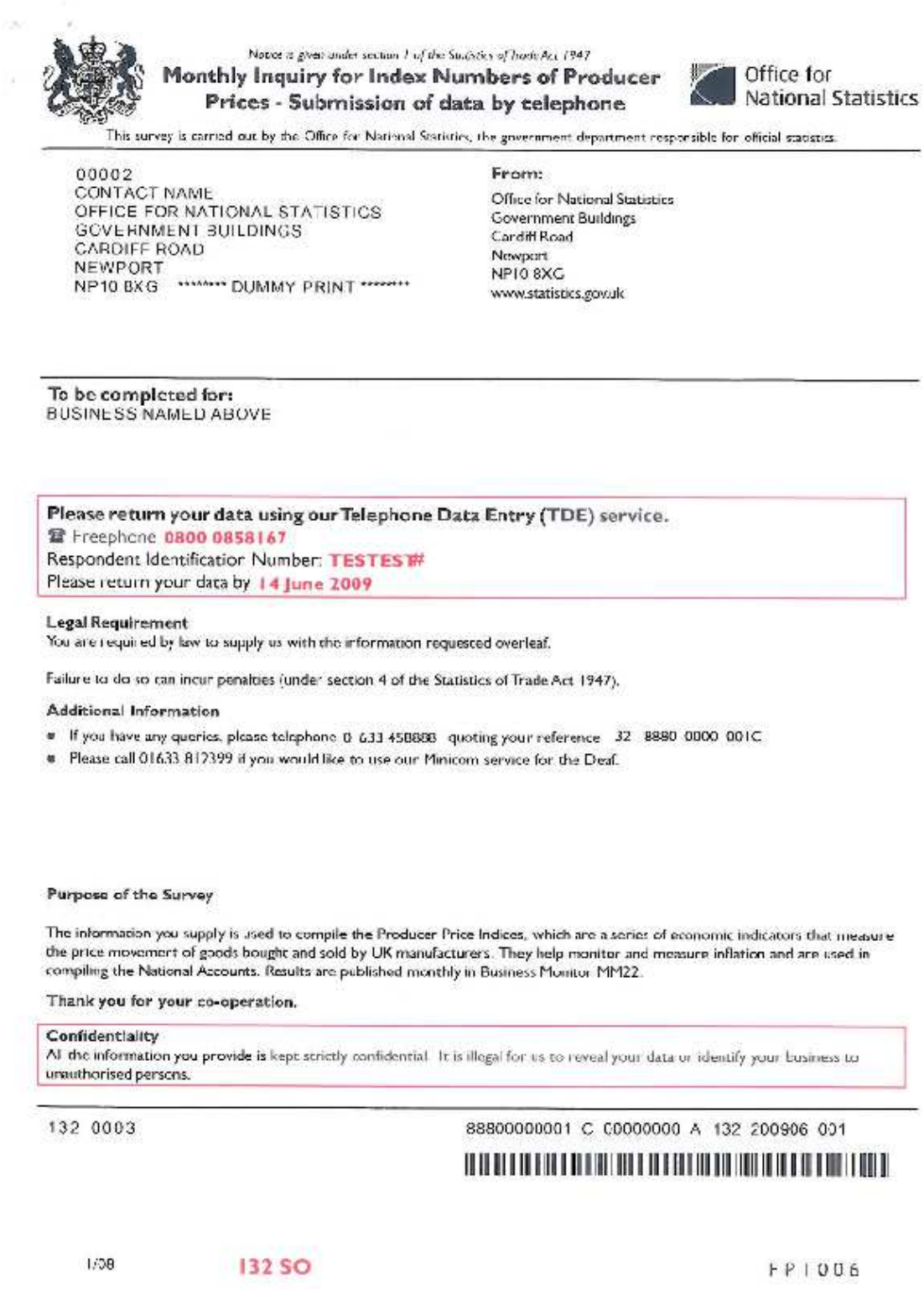
The following table shows the different data collecting methods used in countries. For each country an estimate is made of the proportion of questionnaires that use the specified methods. Following the table are several examples of different price collecting forms and interfaces.

Data collecting methods (%)

	Paper (fax)	Telephone	Online reports	E-mail	Others
BG	55	24		21	
CZ (domestic)	26		24	50	
CZ (non-domestic)	24		74		2
DK	99				1 (internet research)
DE	45	rarely	47	1	6 (for example internet research)
ES	80		20		
FR	52		48		
IT	46		54		
LT	44	5	30	21	
HU	32		37	31	
NL	60	rarely		40	
AT	2	3	90	5	
PL			100		
SI	100				
FI	1		50	49	
SE	44	49		7	
UK	39	60		1	0.4 (publications)
TR	48		2	50	

Source: PPI task force

Paper questionnaire used for TDE – example from the United Kingdom



Notice is given under section 1 of the Statistics of Trade Act 1947

Monthly Inquiry for Index Numbers of Producer Prices - Submission of data by telephone

Office for National Statistics

This survey is carried out by the Office for National Statistics, the government department responsible for official statistics.

00002
CONTACT NAME
OFFICE FOR NATIONAL STATISTICS
GOVERNMENT BUILDINGS
CARDIFF ROAD
NEWPORT
NP10 8XG ******** DUMMY PRINT ********

From:
Office for National Statistics
Government Buildings
Cardiff Road
Newport
NP10 8XG
www.statistics.gov.uk

To be completed for:
BUSINESS NAMED ABOVE

Please return your data using our Telephone Data Entry (TDE) service.
☎ Freephone **0800 0858167**
Respondent Identification Number: **TESTES#**
Please return your data by **14 June 2009**

Legal Requirement
You are required by law to supply us with the information requested overleaf.

Failure to do so can incur penalties (under section 4 of the Statistics of Trade Act 1947).

Additional Information
- If you have any queries, please telephone 0 633 [illegible] quoting your reference 32 8880 0000 001C
- Please call 01633 812399 if you would like to use our Minicom service for the Deaf.

Purpose of the Survey

The information you supply is used to compile the Producer Price Indices, which are a series of economic indicators that measure the price movement of goods bought and sold by UK manufacturers. They help monitor and measure inflation and are used in compiling the National Accounts. Results are published monthly in Business Monitor MM22.

Thank you for your co-operation.

Confidentiality
All the information you provide is kept strictly confidential. It is illegal for us to reveal your data or identify your business to unauthorised persons.

132 0003

88800000001 C 00000000 A 132 200906 001

1/08 **132 SO** FP1006

IMPORTANT

- **Please read these notes before you telephone us.**

All items listed should be **produced** by you in the United Kingdom and sold to the **home market**.

1. Using the Telephone Data Entry (TDE) system

Look at the details on the enclosed sheet(s). Check that you have the prices to hand for the month(s) requested and dial **0800 0858167**. To ensure your telephone is compatible with our system, you will be asked to press '5'. If successful, you will be asked to key in your respondent identification number (this is listed on the attached sheet detailing your products) and to press hash (#) when finished. Then, simply follow the recorded instructions and respond to any question using the keypad of your telephone. If you make a mistake there will be an opportunity to correct it. When prompted to enter a two-digit day code - enter "01" for the 1st of the month, "02" for the second etc.

2. Price basis

The price quoted should:

- be a **normal transaction** price, ie after discounts and excluding VAT.
- be the price you achieve in significant proportion of UK sales, after discounts and excluding VAT.
- reflect orders placed in that month.
- compare **like with like each month**.
- be **representative** of current output.
- normally be sold to customers outside of your company.

3. Price or product changes

If you are prompted by the TDE system to explain why the price of one of your products has changed, please give a detailed reason, eg. the cost of a certain raw material (please specify the raw material concerned) has increased production costs, some aspect of your production has changed, different discount rates etc. If you modify, replace or discontinue any product or alter the unit or terms of sale, please provide details when prompted to do so. A PPI representative may need to contact you to verify any information, or you may be put through to a PPI representative if you require assistance, further information or the products on the attached sheet are not representative of your company's production.

132 0003

88800000001 C 00C00000 A 132 200906 002

PP014B 1/06

Please ring 0800 0858167 **Price(s) required for** OCT 2008

Respondent ID number 1155514 #

Product ID	01	1532100053
Specification	PRODUCT: UNCONCENTRATED ORANGE JUICE DESCRIPTION: 125ML NRB BRIT JUIORG07 SERIAL NO: 208316	
Terms of sale	CUSTOMER REF: UK CUSTOMER PAYMENT TERMS: 21 DAYS DELIVERED PRICE	
Units of sale	24	
Last price returned	FOR SEP 2008 IN POUNDS STERLING	FOR DATA REQUIRED SEE ABOVE

Product ID	02	1532100056
Specification	PRODUCT: TOMATO JUICE DESCRIPTION: 150ML CAN X 24 BRIT JUI TOMATO SERIAL NO: 202588	
Terms of sale	CUSTOMER REF: UK CUSTOMERS PAYMENT TERMS: 21 DAYS DELIVERED PRICE	
Units of sale	24	
Last price returned	FOR SEP 2008 IN POUNDS STERLING	FOR DATA REQUIRED SEE ABOVE

Product ID	03	1532100055
Specification	PRODUCT: UNCONCENTRATED PINEAPPLE JUICE DESCRIPTION: 125ML NRB BRIT JUI PINE SERIAL NO: 208317	
Terms of sale	CUSTOMER REF: UK CUSTOMER PAYMENT TERMS: 21 DAYS DELIVERED PRICE	
Units of sale	24	
Last price returned	FOR SEP 2008 IN POUNDS STERLING	FOR DATA REQUIRED SEE ABOVE

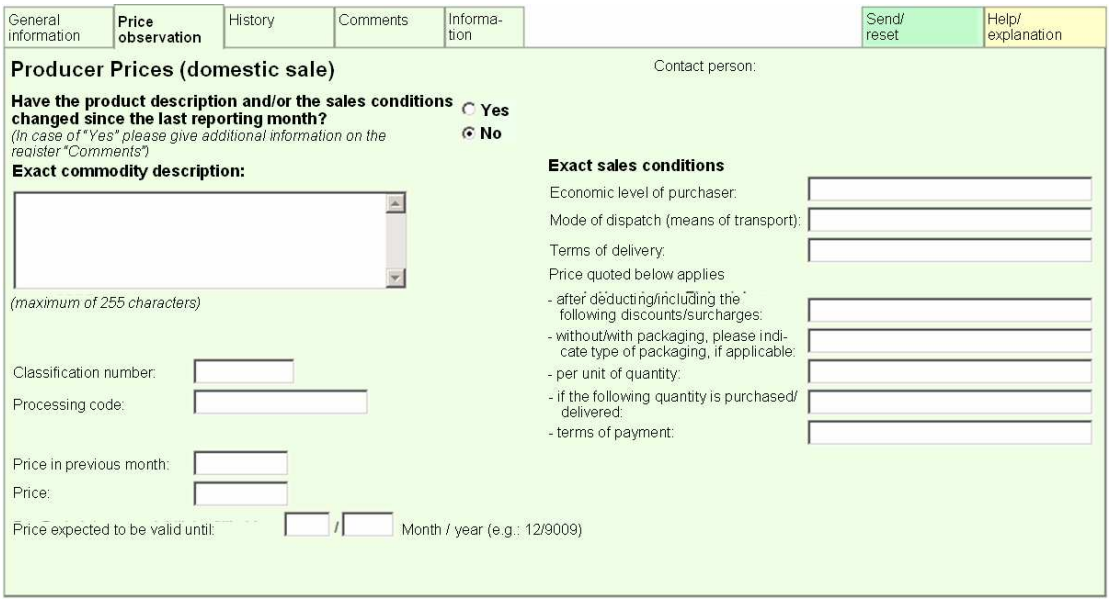
The number(s) in the shaded box(es) are for official use only

132 0003

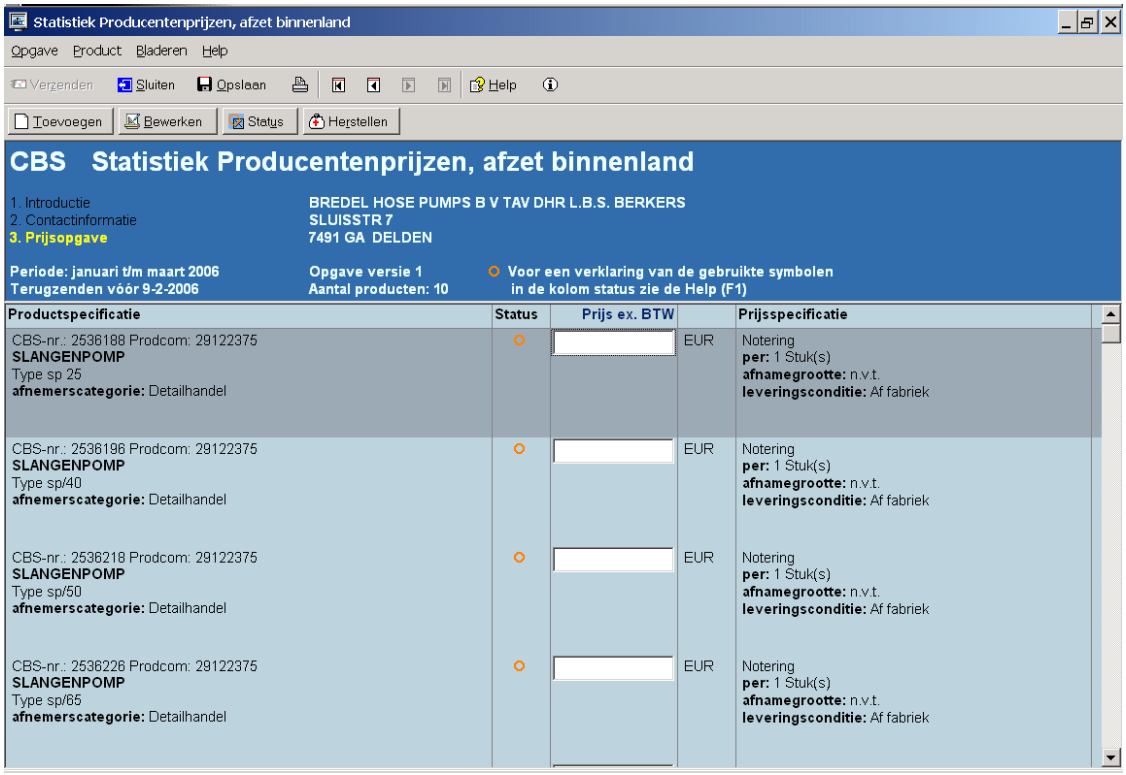
888000000001 C 00000000 A 132 200908 003

PP014C 1/08

Online questionnaire – example from Germany



E-mail questionnaire – example from the Netherlands



Recommendations

IMF recommendations in the IMF manual on PPIs may be found in:

- chapter 6 for price collection,
- chapter 9 for data processing and data editing.

Concerning exchange rates the recommendation of the PPI task force was that the exchange rates should be consistent with the price collection practices, using monthly average rates for monthly average prices and rates for a particular day if prices reflect a particular day.

Chapter 4 Treating unique products and item non-response

Introduction

The aim of the PPI is to measure the average rate of change in the prices of products sold as they leave the producer. The compilation of the PPI should therefore be based on clearly specified, representative products whose prices are followed over time with due attention to quality change. The collection of data is straightforward when a well-defined product exists with stable quality for which transactions can be observed each month – under these circumstances the price can be directly used in the index compilation. In practice however there are particular problems with data collection which represent discontinuity in the index calculation:

- products which are produced only once (one-off or unique products);
- no sale of a given product occurs in a period (the absence of a real transaction) or
- a producer refuses to provide the required price information (item non-response).

In certain activities it is very difficult for contact persons within reporting units to provide prices for the same product over a period of time because much of their work is of a one-off nature. One-off products are usually client-specific and would not be produced otherwise. Thus they cannot be compared month by month. In general the production time of such unique products may be very long and they may not be reproduced for a long time, if ever. One-off products are especially found in:

- machinery and equipment (for example machinery for special purposes like paper manufacturing or mining, quarrying and construction);
- fabricated metal products, except machinery and equipment (for example machining services or forging services);
- repair and installation services of machinery and equipment (for example repair of heavy construction machines);
- motor vehicles, trailers and semi-trailers (for example bodies for motor vehicles);
- other transport equipment (for example ships).

The greatest difficulty with one-off products is to find a detailed specification of a representative product which can be priced month by month. Since one-off products may have a significant impact on the output of manufacturing it is not reasonable to ignore them in the sample used for the PPI. Therefore the use of adequate pricing methods in dealing with unique products is important.

A further problem with calculating a continuous PPI is item non-response. Sometimes a reporting unit is not able to provide the required price information for a specific reference period. Temporarily missing data occurs when the price information in a particular month is missing for example because of holiday, illness or when no contract was concluded in the monitored month (in other words in the absence of a real transaction); the temporarily missing price information has to be estimated by an appropriate method. Permanently missing data occurs when the production of a representative product ceases (for whatever reason); prices are extrapolated (as for temporarily missing data) until a replacement of the representative product or the unit can be found.

From a practical point of view the issues concerning one-off products, the absence of real transactions and item non-response have the same effect: the price of a certain product cannot be observed month by month. This chapter discusses alternative pricing methods (instead of direct pricing) and extrapolation for the missing price information to ensure the index continuity.

One-off products

Methods

There are a number of pricing methods available to solve the problem of one-off products. The selection of the appropriate pricing method depends on the product and activity.

Model pricing

In cooperation with the reporting unit an appropriate model (consisting of components which are representative of the unit's output) will be arranged. The model can be hypothetical or based on a real transaction made in the recent past. The use of a real transaction made in the past is in some cases more convenient to implement because of the reliance on real data from the recent past. An accurate specification of the product and transaction is defined, so that all price-determining characteristics are taken into account. It is essential that the model is specified in sufficient detail that the contact person within the reporting unit can report prices for that defined model and that no variation from the model occurs over time. The estimated price should not only reflect the production costs (including overheads) but also the gross profit margin. This estimated price will be treated as a real transaction price. For each period the contact person within the reporting unit will need to recalculate each component of the model, so that actual production costs and actual market conditions which determine the current profit margin are taken into account.

In practice however it is sometimes difficult to evaluate how well the assumptions to be made reflect reality and in some cases the effort (time) required to provide data for a model can be very high for the reporting unit.

Sub-component pricing

This method is characterised by the use of a number of observed prices of important constant sub-components (key elements) of a unique product. The price entered into the price index is the (weighted or unweighted) sum of prices of the sub-components, which are re-priced in each subsequent period. The use of this approach presumes that the sub-components 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 model pricing where the price is largely based on estimates rather than built up from sub-components for which true transaction prices are available. Care should be taken to ensure the representativeness of the sub-components over time.

Contract pricing

If there is a regular customer (the exact repetition of product occurs for the same customer) over months, the price of this contract can be used, because in this case the price relates to a genuine transaction price. Price changes result from renegotiation, from adjustment (escalation) with an index (like labour and material inputs) or from a clause that states that the producer is allowed to pass on certain cost changes. If this method is used more than one contract should be selected in order to cover different customer types.

Unit value

The contact person within the reporting unit provides unit values (the total sales value of a month divided by the total number of units sold in a month) covering similar transactions for a product or a homogeneous range of products for each period. Unit values can be volatile because they are affected by any change in product quality or by an occasional large order. Such fluctuations reflect changes in customer mix or other sales conditions rather than genuine changes in prices.

Standard version pricing

If a standard version (without tailor-made adaptations) of a one-off product exists the price of the standard version can be used, if the surveyed price also reflects the changes in market conditions.

Percentage price change

In this case the contact person within the reporting unit is asked to provide a percentage price change for a homogenous product in each month. The application of this method depends on the condition that the observed product is sufficiently homogeneous over time and that the price changes include the market conditions.

Pricing based on working time

- Hourly charge-out rates. The use of hourly charge-out rates gives an approximation to the trends of the price of the product itself. The rate covers only one specific type of constant mix of labour and reflects what the customer actually pays (not a list price rate).
- Combination of sub-components and hourly charge-out rates. The appropriate price, which is entered into the price index, is the weighted sum of prices of sub-components and hourly charge-out rates which are combined within the reporting unit. A specific formula agreed with the contact person within a reporting unit is used to calculate the price each month.

Difficulties that arise when using hourly charge-out rates are that they exclude any price movements in the raw materials involved and do not reflect productivity changes over time.

Quality adjustment

If product specifications are replaced by new ones, quality adjustment can be used to adapt the price changes over time. Most of the quality adjustment methods will then try to determine how much of the price change is due to changes in the specification of quality and how much is due to changes in the price. The hedonic model is a specific quality adjustment method which allows the unique model to be valued from its characteristic set. The quality adjustment method is not exclusively used as a pricing method for one-off products, for more details on this topic see chapter on quality adjustment.

In most cases of unique products the application of quality adjustment methods is very burdensome since the products change on an ongoing basis and are often of a very complex nature.

Note: the use of hedonic models for one-off products is often not practical as hedonic models normally require a lot of price and product observations which are rarely available for one-off products.

Use of international prices

If international prices are representative for the domestic production of two countries (the country using the figures and the source country) and for cross-border trade flows, then this approach can be used for handling one-off products. Moreover it is important that the markets must be competitive, the data properly stratified and weighted and a suitable method applied to adjust for exchange rate movements. This method may be especially relevant for import transactions, not exclusively for one-off products but also for irregular imports. The contact between the countries concerned should remain very close in order to exchange experience.

Input pricing

As an approximation for the output price, this approach uses changes in the cost of the major direct inputs over time. The output price is estimated by a function, which consists of:

- the cost of direct inputs, for example materials, major components, labour and energy;
- the cost of indirect inputs and overheads, for example depreciation and administrative expenses;
- productivity in combining the inputs;
- profit margins.

It is important that the selected inputs constitute a large proportion of all inputs and should be updated regularly to ensure representativeness over time. The prevailing (current) profit margins should be taken into account.

Difficulties with methods

A substantial difficulty with the application of the methods mentioned above is to convince the contact persons within reporting units of the value of the pricing method; most of these methods are burdensome not only at the beginning of the data collection but also in subsequent months. In many cases the contact persons within reporting units have to specify a notional product for which a price is then derived each period and this can cause a considerable work load. In order to reduce this problem, a close contact between the statistical office's field officers and the contact persons should be established from the beginning of the data collection. In certain cases (depending on the frequency of changes in market conditions of the unique product) it may be useful to arrange a quarterly rather than monthly reporting of prices. Visiting the producer can also be helpful.

Methods applied in practice

Since one-off products have an important impact on the output of manufacturing they should not be ignored when sampling. Several EU Member States, for example the Czech Republic, Germany, the Netherlands, Austria and the United Kingdom, currently apply methods whereby prices are collected for each period on a specific combination of key elements (model pricing) or where large products are decomposed into a series of more key elements (sub-component pricing). Several prices of unique products such as machinery for paper manufacturing within NACE Division 28 (manufacture of machinery and equipment) or turned metal parts for machinery and mechanical appliances in NACE Division 25 (manufacture of fabricated metal products) are surveyed using these two techniques. Model pricing and sub-component pricing are a very time consuming method for the reporting unit and the statistical office. The response burden for reporting units is very high. An alternative method which is sometimes used for machinery and fabricated metal products is standard version pricing (applied in the Czech Republic, Germany, Spain and Finland).

The working time based method is applied in most EU Member States, for example Denmark, Finland and the United Kingdom, to survey the prices for industrial services (like repair and installation of machinery and equipment and mining support services). The price development of raw materials does not play an important role for some services.

In Bulgaria, Lithuania and Austria contract pricing is often applied for wearing apparel, textiles or distribution and supply service of natural gas. In order to cover different customer types more than one contract is selected.

If a range of one-off products is homogeneous (from one month to the next) the unit value is used in Bulgaria, Lithuania, the Netherlands and the United Kingdom, for example for wearing apparel, mining and quarrying products and printing and recording services.

For unique products, like paper mills, big cruise ships and sporting boats, which are extremely difficult to specify for some countries, the method of percentage price change or input prices is used for calculating the price index, for example in Finland.

A summary of pricing methods applied for one-off products in 16 European countries is shown below.

Pricing methods for one-off products

NACE Rev. 2 Division	Model pricing	Sub-component pricing	Contract pricing	Unit value	Standard version pricing	Percentage price change	Working-time based methods	Quality adjustment	Internatio-nal prices	Input pricing
08				UK						
09	DK		DK				DK, HU			
10			BG, LT							
13	AT		AT	AT		DE				
14	HU	HU	BG, LT, UK	BG		DE		LT		
15	HU	HU								
16	CZ	CZ								
17			HU							
18	FI	HU	HU	LT			HU			
19									NL	
24							NL		NL	
25	NL, AT, SE	AT	BG		CZ, AT		FI			
26	BG, AT				FI		FI			
27	AT	AT		AT, CZ						
28	BG, CZ, DE, NL, AT, SE, UK, TR	BG, DE, HU, AT, SE	NL, UK	BG, NL, AT	DE, NL, AT, FI		UK	TR		FI
29	FI		AT		FI					
30	AT, UK		UK	TR		FI	FI, UK			FI
32						AT				
33	BG, DK, SE		DK	BG			BG, DK, LT, HU, AT, FI			
35			LT, AT							
38			LT							
Not activity specific	FR	FR	CZ, FR, SE, TR	FR	ES, FR, TR	CZ, FR, SI	CZ, SE	CZ, DE, ES, FR, SE	SE	CZ, SE

Source: PPI task force

An overview of examples of pricing methods that are applied for one-off products in eight EU Member States is shown below.

Examples of pricing methods for one-off products

	Model pricing	Sub-component pricing	Contract pricing	Unit value
BG	fire station; refrigerated display case; installation of multiphase electrometers on electrical panel	hydraulic distributor; hydraulic cylinder	various food products (salads, nuts)	men's trousers of wool; ladies' dresses of synthetic fabric lining with short sleeves; hydraulic lift transporter; repair of petrol station instruments and equipment; repair of heavy construction machinery
DK	industrial services		industrial services	
DE	machinery	machinery		
NL				
AT	embroidery of textiles (pieces, strips or motifs); test benches for cars; metal forging services; rail/tramway passenger coaches; illuminated signs, name-plates etc.; derricks; cranes; machines for working wire	accumulator chargers; turned metal parts for machinery and mechanical appliances; hydrodynamic speed variators, torque converters	yarn; silencers and exhaust pipes; parts thereof; distribution and supply services of natural gas by supra-regional gas supply enterprises	rubber thread and cord, textile covered; electric radiators, convection heaters and heaters or fires with built in fans; alternators; machinery or paper and paperboard production; parts of steam turbines and other vapour turbines
FI	bodies for motor vehicles; trailers and semi-trailers; binding and related services	big cruise ships; machinery for paper and paperboard production		
SE	ammunition; machinery and equipment		industrial services	
UK	other transport equipment; machinery and equipment		other transport equipment; machinery and equipment	mining and quarrying products

	Standard version pricing	Percentage price change	Working-time based methods	Input pricing
BG			Maintenance of hoist equipment in nuclear power station; repair of processing machinery; repair of bulldozers; repair of steam generators	
DK			industrial services	
DE	machinery	clothing; textiles		
NL			metal casting	
AT	articles of iron or steel; parts for hydraulic turbines and water wheels	parts of frames and mountings for spectacles	other industrial goods, services and output in the field of manufacturing of machinery and equipment; repair and maintenance of professional television and radio transmitters	
FI	bodies for motor vehicles; trailers and semi-trailers; irradiation, medical and electrotherapeutic equipment; machinery for mining, quarrying and construction	sailing boats	ships; air and spacecraft and related machinery; instruments and appliances for measuring, testing and navigation	paper mills; big cruise ships
SE			industrial services	
UK			other transport equipment; machinery and equipment	

Source: PPI task force

Practical example for one-off products

Manufacture of tools; use of material and labour input prices in a model, example from Statistics Sweden

For price information on the production of unique products it may be preferable to measure a model price every month. The example below is from a unit classified to NACE Rev. 2 Class 25.73 (manufacturing of tools) which produces exchangeable tools for steel manufacturing. By monitoring the reported prices from the unit over a period of time it was obvious that they were not comparable from month to month. After contacting the unit it was also clear that it was impossible to select a representative to measure over time: each tool was unique and was not comparable with another tool. With the contact person in the reporting unit it was concluded that it was possible to take a part of the unit's price setting model and use it as an estimate of a hypothetical but typical and representative product produced by the unit. As a consequence the contact person within the reporting unit provides prices for materials and labour in a model.

Weight structure and price data

The producer price of the hypothetic tool is estimated by a model using input prices. The input is divided into two main groups, namely materials and labour. Among these inputs are important elements for the production and price setting of tools. The distribution between material prices and labour prices is approximately one third and two thirds respectively of the total model price.

A simplified table of this model is shown below.

Material	Price/kg	Weight (kg) (constant)	Price
Steel type A	75	800	60 000
Steel type B	25	200	5 000
Standard components			45 000
Hardening			5 000
Shipping			4 000
Labour	**Price/hour**	**Duration (hours) (constant)**	
Construction	500	150	75 000
Simulation	500	25	12 500
Preparation	500	20	10 000
Measurement	700	25	17 500
Assembly	400	200	80 000
Sum/estimated price for an average tool			314 000

The quantities (weight of steel and working hours), are constant over time, but the prices of the inputs could change from month to month. The non-steel inputs (hardening, shipping and standard components) are ideally constant over time for comparable tools. If they are changed this normally happens on a yearly basis.

The monthly prices for the different steel qualities come from the unit's supplier and represent the monthly changes of the market prices of different steel qualities. The prices of different labour inputs are often changed on a yearly basis.

The prices for material and labour are summarised and this provides an estimated price for a typical tool from the producer.

Conclusion

It should be pointed out that this is not an A-method (according to the Handbook on price and volume measures in national accounts) but it may be considered to be the best method feasible in practice for these kinds of unique products. The advantages and disadvantages of the described model are listed below.

Advantages

- Possibility to measure prices for unique products.
- The contact person/reporting unit feels responsibility for the price report they have developed in the initiation process.
- The statistical office gets information about the price setting philosophy in the specific activity.

Disadvantages

- Time consuming, especially in the initiating phase.
- It can be hard to find contact persons within reporting units with knowledge and understanding of all the factors in price setting for the specific production.
- It is an estimation of a real transaction. Real transactions are often set after negotiations and the latter are not included in the model.
- For a PPI, prices should be measured not costs as is used in the model approach.
- In real transactions the margins are set to a specific customer. In the model margins are not completely included for a specific customer.

Recommendations

Recommendations by IMF

The IMF manual on PPIs recommends the following pricing methods for one-off products, if applied under the right circumstances.

- Model pricing.
- Repeat recent real sale: the contact persons within reporting units are asked to supply the price of a recent sale and to provide a hypothetical price for this exact same representative product for the subsequent months. A replacement is needed, if the order for this specific representative product is not repeated again after a reasonable time (for example six to eight months).
- Standard version pricing (in the PPI manual it is called specification pricing).
- Sub-component pricing.
- Contract pricing.
- Input pricing: this method is unlikely to be satisfactory over the long run, since it assumes that all factors remain constant. In particular, the approach does not always consider the profit margin and may not capture substitution toward more productive inputs.

All pricing methods for one-off products are prone to error, where the market conditions are changing greatly or where the contact persons within reporting units change. The following issues need to be taken into account, to minimise the potential for error.

- Contact persons within reporting units who deliver model prices should be subject to an annual interview. The representativeness of the model should be reviewed and the prices supplied should be checked to ensure that the prices reflect the market conditions.
- In case the contact person within a reporting unit changes, the new contact person should be visited personally and the meaning of model pricing should be explained. The workload for model pricing will be imposed on the contact person. To re-price a specific model on an ongoing basis is a major task for the contact person (most contact persons will be reluctant to do so).

Recommendations by Eurostat

In the Handbook on price and volume measures in national accounts (2001) the following pricing methods for unique products are specified:

- model pricing,
- sub-component pricing (in the Handbook on price and volume measures in national accounts referred to as specification pricing),
- international prices,
- quality adjustment methods,
- unit value method.

According to the relevant Commission Decision the pricing methods in the handbook can be divided into three groups:

A methods: are the most appropriate methods, that approximate the ideal as closely as possible;

B methods: are methods which can be used, if an A method cannot be applied; B methods give an acceptable approximation;

C methods: are methods which shall not be used, because they could generate too great bias.

The A/B/C classification sets out in what direction improvements can be made. The criteria for distinguishing between A, B and C methods are absolute criteria which means that they do not depend upon the present availability of data. Thus it becomes clear where the biggest problems exist in terms of missing data. The classification of methods can diverge from product to product.

The general principles for large equipment according to the Handbook on price and volume measures in national accounts are the following.

- Methods which are based only on model pricing or sub-component pricing, can be stated as A methods, in case the specified model is regularly updated and representative (this is mainly achieved through regular updating, but also a proper range of models across regions is required) as well as actual prices are used. If one of the three key criteria is not fulfilled the pricing method becomes a B method. However model pricing and sub-component pricing are resource-intensive pricing methods.
- Methods which rely on international prices can be regarded as B methods if the prices can be considered representative of the country's domestic production and cross-border trade flows.
- Methods which are exclusively based on input prices (without consideration of profit margins) are C methods. The unit value method is also a C method if the prices do not rely on homogeneous products.
- Methods which are using quality adjustments could be an A or B method, depending on the suitability of the products/activity, for example special purpose machinery or trains.

National accounts recommendations for major products (if the conditions are fulfilled for the respective pricing method):

One-off product	Recommended pricing method according to Eurostat
Trains	Model pricing and appropriate quality adjustment method, for example option prices (A methods)
Special purpose machinery	Model pricing and sub-component pricing (A methods); appropriate quality adjustment method (B method)
Oil rigs	Sub-component pricing (A method, if adjustments for quality are applied to the components); international prices (B method)
Ships	Model pricing (A method)
Aeroplanes	Model pricing and sub-component pricing (A methods)
Defence goods	Sub-component pricing (A method, if adjustments for quality are applied to the components); international prices (B method)

Note: The STS Regulation does not require PPIs for the manufacture of weapons and ammunition, ships and boats, air and spacecraft or military fighting vehicles (among others).

Temporarily missing price information

Methods

In case of temporarily missing price data the following methods can be used.

Expert approximation

An expert within the reporting unit is asked to give an estimate of a price which can be realistically achieved on the market. This method is clearly rather subjective and the results cannot be objectively verified. Nevertheless, if expert knowledge is available it may be a good method to estimate the missing price.

Forward the last surveyed price

Repeating the most recent available price can be appropriate if no new contract was concluded in the latest period or if prices relate to long term contracts. The probability that the price has remained unchanged in such cases is very high.

Extrapolation using the average price development of all remaining products in the elementary aggregate

The price change (between the previous month (t-1) and the month (t) for which the price quote is missing) of a representative product for which the latest price quote is missing can be estimated from the average price change of a homogenous group of similar representative products (all remaining representative products within an elementary aggregate). This method assumes that the other representative products of the same elementary aggregate show similar price developments in a competitive situation. The calculated price change can then be used to estimate the missing price in the latest period.

Extrapolation using the price development of a single comparable representative product from a related reporting unit

This approach uses the price change (between t-1 and t) of a single similar representative product from a related reporting unit and applies this to estimate the missing price in the latest period.

Extrapolation using the price development of a subset of products of the elementary aggregate

This method estimates the missing price using the average price change (between t-1 and t) of a particular subset of representative products within a single elementary aggregate. A special case of this method is

when the particular subset of representative products consists of the other representative products of the same reporting unit. This method can be applied when only some of the representative products of the elementary aggregate are homogeneous and therefore show similar price development.

Extrapolation using the average price development on different levels

The price change (between t-1 and t) of the representative product for which the price quote at time t is missing is estimated by the average price change of a higher (rather than elementary) aggregate, for example at the 6-digit level of a product list or classification. This approach may be appropriate when the representative product for which the price quote is missing is the only one within the elementary aggregate or has a particularly large value of sold production within the elementary aggregate. Otherwise the method should not be applied, since at higher levels the products are generally less homogeneous.

Principles and methods for dealing with missing prices in the compilation of price indices are also outlined in 'Price imputation and other techniques for dealing with missing observations, seasonality and quality change in price indices' (Armknecht and Maitland-Smith, June 1999) and 'Imputation and price indexes: theory and evidence from the international price program' (Feenstra and Diewert, April 2001), which evaluate the alternatives in their studies by the ability to minimise the erratic movement in the price index and still incorporate all available information. This is in contrast to the goal of advanced statistical imputation methods ([2]) where the replacement variable should have a statistical distribution that closely approximates the distribution of the missing variable. Statistical imputation methods need a large scale data base for estimating the missing price data and are difficult to implement, hence these methods are not used in practice for the PPI (in the countries participating in the PPI task force).

Methods applied in practice

Generally, countries face the issue of missing prices each month. The application of the appropriate imputation method depends on the price development over recent periods. For products with homogeneous price-determining characteristics in an elementary aggregate (for example iron, other metals, petroleum) and for representative products with volatile prices (for example oil and gas) countries generally apply an extrapolation using the average price development of all remaining representative products in the elementary aggregate. If the price changes within the elementary aggregate of the missing price quite are dynamic the imputation is based on the price developments of a similar representative product of the same (or a similar) reporting unit or on an extrapolation using the price development of a subset of comparable representative products of similar reporting units.

Forwarding the last surveyed price is often used in European countries for products whose prices usually remain unchanged for several months (for example machinery or seasonal products like wearing apparel in case of summer or winter collections when prices are not available for a few months). This method may also be used in case of the liquidation of a reporting unit if there is no appropriate replacement representative product or no similar representative products within the elementary aggregate which could be used to apply the extrapolation using average price development of the remaining representative products.

If the contact persons within reporting units have excellent knowledge of market conditions of the missing price some countries, for example Bulgaria and Lithuania, apply the method of expert approximation for temporarily missing price data.

Extrapolation using the average price development at a higher aggregation level is sometimes used in Spain and Lithuania if the missing price concerns a representative product that is the only one in the elementary aggregate or if the missing price is for a representative product with a large share of production value in the elementary aggregate.

An overview of the frequency of application of various methods for treating temporarily missing price information is presented below for a selection of countries.

([2]) See Little and Rubin; Data editing with artificial neural networks (Braten, Arne, December 1997); Traditional and new methods for imputation (Laaksonen, Seppo, December 2002).

Application of methods for temporarily missing price information

	Expert approximation	Forward last surveyed price	Extrapolation using all remaining representative products in the elementary aggregate	Extrapolation using a single representative product from a related producer	Extrapolation using a subset of representative products in the elementary aggregate	Average price development at a higher level
BG	sometimes	sometimes	often	often	rarely	rarely
CZ	rarely	often	sometimes	sometimes	often	often
DK		often	often			
DE	rarely	often	often	sometimes (domestic)	rarely	
ES	rarely	sometimes	often			sometimes
FR		sometimes	often	rarely		
LT	sometimes	often	often			sometimes
HU		often				
NL		sometimes	often	often		sometimes
AT	rarely	sometimes	often			
SI	rarely	sometimes	sometimes			
FI		often	often	rarely	rarely	rarely
SE	rarely	often	sometimes	often	rarely	rarely
UK		rarely	often			
TR	rarely	sometimes	often	often		

Source: PPI task force

Example for temporarily missing price information

An example for extrapolation using the average price development of all remaining representative products in the elementary aggregate is provided below.

Example calculation for a temporarily missing price

Representative product$_i$ of the elementary aggregate	Reference price for year t_0=100	Price (t-1)	Price (t)	Price relative / index (t-1)	Price relative / index (t)	Including imputed data: Price change between t-1 and t (%)	Including imputed data: Price (t)	Including imputed data: Price relative / index (t)
RepProd $_1$	40.0	50.0	53.5	125.0	133.8	7.0	53.5	133.8
RepProd $_2$	55.0	70.0	71.5	127.3	130.0	2.1	71.5	130.0
RepProd $_3$	67.0	80.0	?	119.4	?	2.9	**82.3**	122.8
RepProd $_4$	65.0	87.0	90.0	133.8	138.5	3.4	90.0	138.5
RepProd $_5$	87.0	100.0	100.0	114.9	114.9	0.0	100.0	114.9
RepProd $_6$	82.0	95.0	97.0	115.9	118.3	2.1	97.0	118.3
Subset which includes all representative products of the elementary aggregate except number 3 (=*S*)				123.2	126.8	**2.9**		
Elementary aggregate (=*EA*)				122.5		2.9		**126.1**

The first stage is to calculate the average price change of all remaining (therefore available) representative products in the elementary aggregate between t-1 and t. This is done by compiling an index (using geometric mean) for the subset of all representative products within the elementary aggregate apart from the missing one for both periods (t-1 and t) and then calculating the change in this index.

$$PC(t-1,t)=\frac{l_S(t)}{l_S(t-1)}\times 100-100=\frac{126.8}{123.2}\times 100-100=2.9$$

where:

S = subset of representative products of the elementary aggregate (EA) other than the product with a missing price,

$$S\subseteq EA, S=\{RepProd_1, RepProd_2, RepProd_4, RepProd_5, RepProd_6\}$$

$l_S(t)$ = price index of subset S in period t

$l_S(t-1)$ = price index of subset S in period t-1

The second stage is to estimate the missing price (for the representative product 3) in period t:

$$\hat{P}_{RepProd_3}(t)=\frac{P_{RepProd_3}(t-1)}{100}\times PC(t-1,t)+P_{RepProd_3}(t-1)=\frac{80}{100}\times 2.9+80=82.3$$

where:

$P_{RepProd_3}(t-1)$ = price of representative product 3 in period t-1

The final stage is to perform the regular index calculation for the elementary aggregate in period t, using price relatives based on observed and estimated prices: the index calculation is done as a geometric average of the price relatives of the individual representative products.

$$l_{EA}(t)=\sqrt[n]{\prod_i^n l_{RepProd_i}(t)}=\sqrt[6]{133.8\times 130.0\times 122.8\times 138.5\times 114.9\times 118.3}=126.1$$

where:

$l_{RepProd_i}(t)$ = price index (relative) of product i in period t

Recommendations

The IMF recommendations for temporarily missing prices are:

- Omit the product for which the price is missing: like is compared with like, but this approach reduces the sample. Omitting an observation from the calculation of an elementary index changes the implicit weights attached to the other prices in the aggregate.
- Carry forward the last observed price: this method is acceptable only for a very restricted number of periods and should be avoided whenever this is possible. This method is simple to apply but if the representative product remains without a new observed price for some periods the resulting index tends to zero change. In addition, there is a compensating step-change in the index when the price of the missing product is available again. In general, carry forward the last surveyed price is not an adequate method for temporarily missing price information unless there are reasons to believe that the price remained unchanged.
- Impute the missing price by the average price change for the representative products that are available in the elementary aggregate: This method can be used, if the prices of representative products in the elementary aggregate can be expected to move in the same direction. The imputation is numerically equivalent to omitting the representative product with missing price information for the immediate period.

- Impute the missing price by the price change for a particular comparable representative product from a similar reporting unit: depending on the homogeneity of the elementary aggregate, it may be preferable to use only a subset of representative products from the elementary aggregate or a single comparable product from a similar type of reporting unit to estimate the missing price information.

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Chapter 5 Pricing industrial services

Introduction

The compilation of price indices should be based on clearly specified, representative products whose prices are followed over time with due attention to quality change. The effectiveness of pricing to constant quality depends on the extent to which all the price-determining characteristics of the representative product (and more broadly the transaction) can be identified and specified and then monitored over time. In the case of industrial services, it is more difficult to follow the above mentioned criteria for price collection for the following reasons.

- Services are often unique as they are typically produced and delivered in contact with the customer - there is a more frequent occurrence of unique products for services than for goods. A unique service is one that is only provided once to the specifications of an individual customer and prices cannot be observed monthly.
- The identification of relevant characteristics for services is more complex than for goods.
- Controlling for quality changes is more difficult for services than for goods.

The PPI survey covers mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply and water supply. According to NACE Rev. 2 a major part of industrial services are concentrated in 'repair and installation of machinery and equipment' (Division 33) while another services-producing activity is 'printing and reproduction of recorded media' (Division 18). More broadly, industrial services can be summarised in the following four categories.

Repair and maintenance

Repair and maintenance includes repair of fabricated metal products, repair and maintenance services of machinery, engines, turbines, vehicle and cycle engines, lifting and handling equipment, electronic, optical and electronic equipment, ships, boats, aircraft, railway and tramway locomotives and rolling stock and so on. According to NACE Rev. 2 these services are classified in 'repair of fabricated metal products, machinery and equipment' (Group 33.1).

Assembly and installation

Assembly and installation includes installation services of steam generators, office machinery, engines, turbines, pumps, compressors, lifting and handling equipment, non-domestic cooling and ventilation equipment, special purpose machinery, professional electronic equipment, electric motors, generators and transformers and so on. According to NACE Rev. 2 these services are classified in 'installation of industrial machinery and equipment' (Group 33.2).

Contract processing (outsourcing)

Contract processing is used in cases in which a unit (the principal) contracts another unit (the contractor) to carry out parts of a production process or even the full production process. The principal does not physically transform the goods but often owns the physical inputs to the transformation process, the copyright to the design of the goods, bears the commercial responsibility and risk for the goods produced and exerts significant control over the production process. The contractors do not own nor sell the produced products, but sell their service and receive payments for that (effectively covering the processing costs and their profit margin).

According to NACE Rev. 2 a principal that owns the material inputs and has economic ownership of the production, as well as a contractor that actually carries out the manufacturing process and provides manufacturing services are both classified to manufacturing (Section C). Therefore, their turnover is included in the turnover of the relevant manufacturing activity and these units (principals and contractors)

should be covered by the scope of the PPI and might be included in the PPI surveys – principals would be surveyed concerning the price of the goods and contractors for the price of the manufacturing service.

Other industrial services

Other industrial services include printing services and services related to printing, reproduction services of recorded media of sound recording, video recording, reproduction services of software, casting of metals, forging of metals and treatment of metals.

Methods

Because services are often unique, for example they are often performed once for a particular customer and then never again, the standard price measurement methods cannot be used very often. Decisions on pricing methods depend on particular circumstances, and different price measurement methods are used.

An important part of the work is to visit the reporting unit in order to identify the services. It involves identifying those service characteristics that are price-relevant and distinguishing between apparently similar services. During the visit an understanding needs to be reached concerning the services provided, how the service can be measured, what the price-determining characteristics are and what contracts are signed.

The different price measurement methods are described below:

Direct use of prices of non-unique, repeated services

Transaction prices

This method concerns the standard case of well-specified, repeated services. Two conditions are characteristic of a transaction price:

- the service must be relatively homogeneous and sold regularly to different customers;
- the price must be the actual sales price.

In this method, producers are asked to select some of their services that are representative of their total output. The prices of these services are followed over time, as well as all price-determining characteristics in order to control for quality changes. Sometimes list prices are used, which relate to standard price lists established by a reporting unit for the services they sell. The list prices should only be used if there are good reasons to believe that they reflect the development of real transaction prices. This is not the case when discounts vary over time in response to changing market conditions.

Contract pricing

Contract pricing is used if there are long-term contracts for repeated services in many survey periods. The conditions are characteristic of a contract price are:

- there must be a long term contract for a regular service for one and the same customer;
- the price must be the real sales price.

Application of this method requires a particular pricing mechanism, namely that the producer and the client establish one contract that covers the repeated delivery of the service during a long period, either a predefined period (for instance one year) or an open ended period. For this pricing method it is necessary that the contract lasts a sufficiently long period and that the provision of the service is repeated at least once per survey period. In this pricing method, the major price movements occur when the contract expires and is replaced by a new one – when contracts are reviewed (usually once a year) prices are changed or quality adjustments made.

It is necessary to analyse the contract and to take into account all details which concern prices. Contract types are grouped into two broad categories: fixed price or cost reimbursement.

Fixed-price contracts

Fixed-price types of contracts provide for a firm price, or, in appropriate cases, an adjustable price. Fixed-price contracts providing for an adjustable price may include a ceiling price, a target price (including target cost), or both. Usually the ceiling price or target price is subject to adjustment under predetermined circumstances.

Cost-reimbursement contracts

Cost-reimbursement type of contracts provide for payment of allowable incurred costs, to the extent prescribed in the contract. The contracts establish an estimate of total cost for the purpose of making funds available and establishing a ceiling that the contractor may not exceed (except at own risk) without the approval of the principal.

Other contracts

There are also time-and-materials and labour-hour contracts where the payments include the materials (including components) and labour or only the labour costs.

Difficulties

One problem experienced is that sometimes services are provided on the base of long-term contracts with pre-payments rather than payments on an ongoing basis. Services are provided continuously and prices should be allocated to the whole period but because of the pre-payments and the long-term contract there is no possibility to say whether the price for the delivery of the service is the same throughout the period or whether it varies.

Unit value

In this method, the first stage is to try to identify homogeneous services. A broadly defined service may be divided into more detailed services for which more precise specifications can be produced. In practice, the homogeneity requirement may not be fully met. If the specification of the services is too detailed it becomes impossible for the reporting units to find similar services every month. Nevertheless, unit values may provide the best option, even for complex services.

Services might change over time and the homogeneity lost. Changes in the composition of different services can lead to changes in the unit value index that are wrongly interpreted as price changes. Thus, the division into detailed services needs to be checked frequently and updated if necessary to avoid an index bias.

Model pricing

In this method, a reasonably typical service (or services) is selected and fully specified in terms of all the price-determining characteristics. The reporting unit is then asked each month to re-quote, on a competitive basis, for that particular service, even though there may not be an actual order for it. The service need not have been performed at the time when data is collected - it is sufficient for the reporting unit to be able to make an estimate of the price.

When estimating a price, the following factors should be considered:

- labour costs (staff by skill/experience level and number of hours);
- overhead costs;
- gross profit margin (the representative margin that would apply in the current competitive climate).

The hardest aspect is to ensure that a realistic profit margin is included in the total price reflecting the current market conditions. If competition is strong, then the profit margins that can be attained may be small. On the other hand, if there is strong customer demand, it may be possible to increase profit margins.

In calculating the price that should be reported to the statistical office reporting units should try to avoid considering the exercise as purely academic or statistical. Rather, they should treat the statistical office as though it was a real customer putting in an actual order each month. In this way, reporting units should follow their normal costing and pricing practices and reflect price changes attributable not only to changes in costs of materials, labour and overheads (such as rent and energy costs), but also to profit margin variations that reflect prevailing market conditions.

It should be borne in mind that the objective of model pricing is to obtain an indicator of short-term price changes prevailing in the market. It is not necessary to require precise figures for the price level of a highly complex commercial contract which may take hours for the reporting unit to calculate and check. Thus, it may be acceptable to simplify the model somewhat provided it remains sufficiently precise to ensure consistency of pricing over time.

The problem with this method is that it is very difficult and time consuming, both for the reporting unit and for the statistical office. Another problem is that some uncertainty arises in the price indices because of the subjective nature of the pricing method.

Pricing based on working time

Pricing based on working time differs from other pricing methods in the sense that the price of the service finally provided is not identified but prices of time spent in service provision are used instead. Services are assumed to correspond directly or predominantly to different types of chargeable hours, actually worked for a client.

Pricing based on working time is applied for services where hourly rates are typically used as a pricing mechanism. The resulting measure in this method is the price development of working time spent in service provision rather than the price development of the service itself.

The target measure is directly the price of chargeable working time. Thus, the method is in principle straightforward. Availability of price data varies, however, in practice and therefore the method has several variants.

Hourly charge-out rates

The hourly charge-out rate method represents the simplest case where transaction prices are available by labour categories. Reporting units provide average hourly rates charged subdivided by type of labour that can be taken directly from ongoing projects or newly concluded contracts, or – more subjectively – they can reflect the reporting unit's estimate of the general market situation. The overall price change is a weighted average of changes of charged hourly rates in different labour categories.

Hourly list rates

Transaction prices of working hours are not always available. However, many producers compile a list of hourly rates for different staff levels; some producers may have individual rates per person that are typically drawn up once per year. If these hourly list rates serve as a reference rather than as the charging rates actually transacted adjustments based on the difference between attained (real) and implied (list) income should be made.

Wage rates

Sometimes no charge-out rate data are available because the invoicing is based on a system other than the direct use of hourly rates. Instead, data on hourly wage rates might be used as a starting point in these cases. Reporting units are asked to provide data on wages for a number of types of professionals and additionally the number of hours worked for clients by each type.

Productivity issues with working time

The problem in the methods based on working time is that no change in productivity is reflected in the price measures. Productivity improvements should be measured and integrated in the price changes. The pricing method where pricing is based on working time has, in principle, a potential productivity bias, but in some cases such time based methods may be the only solution.

Methods applied in practice

Price surveys are based on NACE Rev. 2 (generally since 2009) and the most important part of industrial services are concentrated in NACE Rev. 2 Division 33. The table below shows the percentage share of this division within total industry, based on turnover.

Percentage share (weights) of NACE Division 33 (repair and installation of machinery and equipment) in total industry, 2005

	Domestic turnover		Non-domestic turnover	
	EU-27	EA-17	EU-27	EA-17
Repair and installation of machinery and equipment	2.2	2.1	2.4	1.9

Several countries participating in the PPI task force provided information on the main areas where they include industrial services for the PPI and an indication of the importance of these services – the information is summarised in the table below.

A summary of the countries answers on prices of industrial services

	Relevant NACE Rev. 2 activities	Share of manufacturing turnover (%)
Repair and maintenance		
BG	Group 33.1	1.86
CZ		2
DK		2.14
LT		2.11
HU		0.3
NL		< 1
AT		1.03
PL		? 1.3
FI		? 0.8
SE		2.1
Assembly and installation		
BG	Group 33.2	0.16
CZ		1.4
DK		0.23
LT		0.05
HU		0.26
NL		< 1
AT		0.86
PL		? 0.4
FI		? 0.5
SE		0.7
Contract processing		
BG	Division 14, Group 15.2	It is difficult to calculate contract processing share in manufacturing turnover due to the mixed production in different contracts.
LT	Divisions 12 and 14	
AT	Group 13.3	
FI	Division 24, Group 29.1	
SE	Classes 17.11(2), 24.44, 25.61, 33.12 and 33.13	
Other		
BG	Division 18	0.81
DK	Division 09	0.09
FR	Division 18	
LT	Divisions 18 and 38 and Class 35.12	1.46
AT	Division 18	2.01
SE	Classes and Groups 10.85, 18.11, 18.12(2), 22.11, 24.51, 24.53, 25.5, 25.61, 25.62, 33.2, 38.1 and 38.2	4.1

Recommendations

The IMF manual on PPIs, the IMF manual on export and import price indices as well as the Eurostat STS methodological manual do not provide any specific recommendations on the treatment of prices of industrial services. In the IMF manual on PPIs it is stated that the rules for the price survey are equally valid for goods and for services: 'The general purpose of an index of producer prices is to measure changes in the prices of goods and services produced by businesses' or 'The purpose of an index number may be explained by comparing the values of producer's revenues from the production of goods and services in two time periods'.

Chapter 6 Transfer prices

Introduction

Transfer prices refer to artificially high or low prices on transactions between related legal units (for example, companies) which are different from the normal market prices for similar products: normal market prices are sometimes called arms' length prices. Transfer prices are generally applied by international enterprise groups to redistribute profits to their affiliates in countries where they will be least taxed.

Methods

The treatment of transfer prices in PPI should be seen in the broader context of their treatment in other, related economic statistics.

Other economic statistics

In external trade statistics there has a long standing recommendation that where prices reported to customs are obviously not normal market prices they should be replaced by market prices. However, it is not clear how often this replacement is made in practice.

In the methodology for structural business statistics transfer pricing is not explicitly mentioned, but the SBS data is extensively based on accounting data so would usually register the price recorded in the company accounts, which is likely to be the price actually paid. Recently the question arose too for the inward FATS data, more particularly regarding the inclusion of intra-group trade in total turnover. Eurostat's view is that it should be included, even though it might not correspond to the real value of the goods or services. The flows have to be taken into account and it would be virtually impossible to correct these flows to their real values.

In national accounts which are an integrated system, adjusting the value of any goods and services transaction involves repercussions for the other party to the transaction as well as in the financial account and possibly the income account. SNA 2008 recognises that in practice this is rarely possible.

An EU task force on the measurement of gross national income concluded that in general users could benefit more from a separate identification of intra-group imports and exports of goods and services (which may be affected by transfer pricing) than from intensified efforts to make imputations of market prices. It might be difficult to compile data on intra-group imports and exports of goods and services in practice, but the availability of such data could be useful for analytical purposes.

Transfer prices in PPI

In existing documents on the PPI there are few clear references to the treatment of transfer prices. The STS Commission Regulation on definitions (1503/2006) explicitly states for the import price index: "Intra-company transfers should be taken into account as long as these transfers are based on prices which are market based or market influenced or if market prices are insignificant". However for the output prices variable (PPI) there is no such statement; this seems inconsistent and may well be due to the PPI definition having been drafted many years earlier and not having been (sufficiently) updated.

It should be remembered that the PPIs serves two main purposes – as indicators of price change and deflators of current price values. As indicators of price change, indicators with and without the artificial transfer prices would both be interesting: this is acknowledged in the IMF manual on PPIs (see the extract below).

As deflators, the PPI should reflect transfer prices in the same way as output data (for example turnover or production value) does so that the volumes are correctly estimated. It may be assumed that the extent of transfer pricing between resident enterprises would be small, therefore the transfer prices would affect mostly the non-domestic PPI and non-domestic output measures. As such, the issue centres on how export (and import) prices are recorded.

Recommendations

PPI task force recommendations

The PPI task force recommends the inclusion of transfer prices in the PPI.

Excerpt from the IMF manual on PPIs

'B.4. Intracompany transfer prices

3.34 Intracompany transfer prices are of increasing importance as globalisation progresses, as discussed in Section A.5. Intracompany transfer prices are defined as the value assigned on a per unit or per shipment basis to goods shipped from one establishment of an enterprise to another. Ownership of the good does not change hands, so the value assigned to the shipment is not a market price. Where there is a vertically integrated enterprise, these shipments cross industry lines and account for revenue within that product line. Therefore, they are reflective of output-generating activity in the domestic economy.

3.35 One of the primary goals of the PPI is to help determine the magnitude and direction of price movement on both a macro- and microeconomic level. Price movements at earlier stages of processing or within intermediate demand are often of the greatest interest to policymakers concerned with price inflation. For such a use, any index containing nonmarket prices not paralleling market price movement is of dubious value. Intracompany transfer prices may well distort price analysis of market trends in the domestic economy.

3.36 It is generally recognized that the statistical agency must research the basis for setting intracompany transfer prices to determine how closely they proxy market prices. Often, vertically integrated companies establish separate profit maximizing centres (PMCs) and allow the use of market measures to determine the performance of each unit. In such instances, intracompany transfer prices generally meet the test as good market price proxies.

3.37 Where tax considerations are important in price setting, intracompany transfer prices are generally poor proxies. Internationally traded goods might have valuations set to minimize import tariffs and corporate taxes. The statistical agency may decide to exclude such intracompany transfer prices from the index when they are judged to be accounting entries with no relation to market prices or values sensitive to taxation. On the other hand, to the extent that such activity is a significant portion of an industry's output, it is important to get the best proxy prices available because they will be needed to derive the industry PPI for use as a deflator in compiling GDP. In the case of exported goods, these may be the only prices available, and they will reflect the actual export values.'

IV

Quality change

Chapter 7 Quality change

Introduction

The producer price index is intended to reflect pure price change over time and to do so by measuring prices for a constant quality. It is not a simple objective to achieve because the characteristics of products being sold in the market place and the conditions of their sale change over time. If there has been a change in either the representative product's specification or the sales conditions, the resulting observed price change (the price difference between the transactions before and after the change) may include a combination of a pure price change and a change in quality. It is essential that a change in the quality of the product should not lead to a change in the index since the index should only reflect the pure price change. As a price index must reflect pure price change, adjustments must be made for changes in the characteristics (or changes in quality) or sales conditions of individual goods and services. These adjustments are called quality adjustments.

The reported or observed price change (Δp) can be sub-divided into two elements, that is a real (pure) price change (Δp_p) and a quality change (Δp_q), and can be portrayed by the following formula.

$$\Delta p = \Delta p_p + \Delta p_q$$

Where

Δp = observed/reported price change between two periods

Δp_p = real price change between two periods with comparable price-determining characteristics

Δp_q = apparent price change caused by a quality change between two periods

The IMF manual on PPIs (paragraphs 1.213 – 1.216) notes that for the 'purposes of the PPI output indices (and output indices in general), a quality change must be evaluated from the producer's perspective with regard to the revenue received. The evaluation of the quality change is essentially an estimate of the per-unit change in revenue that a producer will receive for the new characteristics possessed by the new quality using the same production technology. This amount is not a price change because it represents the monetary value of the change in the value of production that is involved to produce the new quality. The value can either be estimated on the basis of the value to the user of the new quality, or the production costs from the producer'.

In the earlier chapter on price-determining characteristics it was already noted that, when selecting the representative products that will be observed, the products should be produced continuously over time to the same level of quality, as well as having a high degree of representativeness. The aim therefore is to identify products for which, where possible, no changes to the product specifications are anticipated in the future.

In reality, markets are dynamic and continuously undergo structural changes for a variety of reasons. Products change or disappear from the market and completely new products are introduced. Selling conditions change and there are changes in the population of enterprises (such as insolvencies, start-ups, mergers and demergers) which may lead to different products entering the market.

These continuous quality changes must be identified and taken into account when calculating the index. Reporting units must note changes in the product specifications or sales conditions when reporting prices. Equally, when substantial price changes are observed, the reasons for the change should be investigated with the reporting units. Depending on the nature of the change, various procedures and possibilities to adjust for the quality change can be applied.

Within the statistical office a decision should be taken, case by case, which quality adjustment procedure to implement. The objective for the staff of the statistical office is to determine the pure price change (Δp_p) between the old and new representative products.

Methods

Overview of possible quality adjustment procedures

Generally, when a quality adjustment is made it is applied to either the previous month's price or the base period's price for the new product representative, as will be demonstrated later. The estimated previous month's price is generally not necessarily observed directly, but represents the price which the new product representative would have achieved in the previous period. When comparing this estimated price of the new product representative with the observed price of the old product representative, the difference between the two can be regarded as the value of the different characteristics. A new estimated base price can also be calculated using the assumption that between the base period and the previous period the new product representative had undergone the same price changes as the old product representative.

The comparable previous month's price can be calculated in various ways, depending on the quality correction method used. The most common methods are described below: which of these are appropriate in each individual case depends largely on the additional information available and assumptions about the quality change. Furthermore, the market conditions exert a major influence on the choice of quality adjustment method. If a new product is launched as a replacement for one which has been removed from the market the observed price change is, in most cases, a combination of quality change and pure price change.

Procedures if the old and new representative products exist in the market at the same time:

- unadjusted price comparison (or direct price comparison or comparable replacement),
- chaining (or link-to-show-no-price-change),
- overlap pricing,
- option prices.

Procedures if the new and old representative products do not exist in the market at the same time:

- expert estimation,
- matched model approach,
- hedonic approach.

Procedures of quality adjustment

Unadjusted price comparison

This method is also known as direct price comparison or comparable replacement.

This procedure assumes that there is no quality change between the old product representative and its replacement, the new product representative. This procedure allocates the entire observed price change to pure price change ($\Delta p = \Delta p_p$) by presuming that no quality change has occurred ($\Delta p_q=0$). The new product representative is treated as a complete replacement of the old product representative and the calculation of the price index is performed without adjustment.

Example of unadjusted price comparison

	Date of observation				
	t – 2	t – 1		t	t + 1
Product m (old)	10	10	$\Delta p_q = 0$	—	—
Product m (new)	-	(10)		11	12
			$\Delta p_p = 1$		
Index	110.0	110.0	→	121.0	132.0

The calculation for the product representative m is the following: $\Delta p_p = P^t_{m(new)} - P^{t-1}_{m(old)}$

Where:

Δp_p = pure price change

$P^t_{m(new)}$ = price of new product representative in the current month

$P^{t-1}_{m(old)}$ = price of old product representative in the previous month

This method is applicable if there is:

- negligible difference in quality;
- no additional information available.

When using this method the observed price difference between the old and new representative products is due to pure price change, not quality change.

A direct price comparison is appropriate if the comparable previous month's price cannot be directly ascertained and if the new product representative differs only in ways which have no influence, or only a very slight influence, on the product quality.

One example of this may be clothing where an item is manufactured for a new season with the same quality as was produced for the representative product of the previous season, but where that representative is no longer available.

However, caution needs to be taken with any automatic use of this method as it will miss any development of products in the marketplace. Especially in case of technical development this method would not be an appropriate choice.

Chaining

This method is also known as link-to-show-no-price-change.

In chaining it is presumed that the difference between the prices of the old product representative and the new one is caused exclusively by a change in the product quality. The entire price difference between two periods is assigned to a quality change (Δp_q) and as a consequence there is no pure price change. This quality change Δp_q must not have an impact on the producer price index and therefore Δp_p is defined as 0.

Example of chaining

	Date of observation				
	t – 2	t - 1		**t**	t + 1
Product m (old)	10	10	$\Delta pq = 30$	—	—
Product m (new)	-	(40)		40	50
			$\Delta p_p = 0$		
Index	110.0	110.0	→	110.0	137.5

This method is only applicable if:

- the quality differs by a large amount; and
- no alternative information is available to apply another quality correction procedure.

When using this method: the whole price difference between the old and new representative products is due to quality, and there is no pure price change.

The method of chaining should only be used if there is a considerable quality difference between the old and new representative products, and no additional information is available for the application of another quality correction procedure. Applying the chaining quality adjustment procedure will bias the index to show no price change over time (in other words a downwards bias when prices are increasing and an upwards bias when prices are falling).

Overlap pricing

In the method of overlap pricing, the old and new representative products overlap in the market, meaning that there is a price for both representative products in a period. As such, the price difference observed in the market can be assumed to be the quality difference. A comparable previous month's price can therefore be directly observed.

The advantage of this method lies in the fact that the price difference can be subdivided by simple calculation into the elements of the quality change and pure price change. An attempt should therefore always be made to overlap the price reports in the event of a change in the quality. Frequently this may require further contact with the reporting unit as generally only the current price for the representative product being observed is reported.

Example of overlap pricing

	Date of observation			
	t – 2	t – 1	t	t + 1
Product m (old)	10	10	—	—
Product m (new)	18	19	20	21
Index	110.0	110.0 (110.0)	→ 115.8	121.6

$\Delta p_q = 9$

$\Delta p_p = 1$

The calculation of Δp_p for the product representative m is the following: $\Delta p_p = P^{t}_{m(new)} - P^{t-1}_{m(new)}$

Δp_p= real price change

$P^{t}_{m(new)}$ = price of new product representative in the current month

$P^{t-1}_{m(new)}$ = price of new product representative in the previous month

The calculation of Δp_q is the following: $\Delta p_q = P^{t-1}_{m(new)} - P^{t-1}_{m(old)}$

Δp_q= quality change between old and new representative products

$P^{t-1}_{m(new)}$ = price of new product representative in the previous month

$P^{t-1}_{m(old)}$ = price of old product representative in the previous month

One aspect of this method that should be considered is the position in the product life-cycle of the two representative products. It is common for producers to operate a special price policy when introducing or removing a product and so the price mechanisms of representative products that replace one another are not identical. If the reporting unit is not involved in determining the best time to change from the old product representative to the new one this issue may not be appropriately taken into account when using the overlap pricing method. If this issue is neglected, then there is a risk that too little or too much of the observed price change in the overlapping period may be attributed to differences in quality. If for instance the old product representative has a particularly low price in period t-1 (in order to run-down stocks on introduction of the new product representative), Δp_q will be valued too high, and hence the pure price change Δp_p between t-1 and t will be valued too low. In contrast, if there is a special price campaign accompanying the introduction of the new product representative, the quality change Δp_q is valued too low and so a higher pure price change is recorded between period t-1 and period t. Ideally, the transition from the old product representative to the new one should take place at a time when both products are in a stable market position. As mentioned above, in order to achieve this it is normally necessary to involve the reporting unit in the decision-making process.

This method is applicable if:

- the old and new representative products are available in an overlapping period of time.

This method should not be used to replace a product representative sold at a ‘clearance’ price with a new product representative at full price.

When using this method: the observed price difference between representative products available in the market at the same time is accepted as the quality difference. Pure price change is measured by the price change of the representative products in each period.

Option prices

The use of option prices is contingent on the possibility to describe precisely the quality of the characteristics that change between the old and new representative products. The price of these changed characteristics need to be valued. In the event that the new product representative includes additional equipment items, these items are individually valued with their corresponding prices, which in turn are used to calculate the amount of quality difference between the old and new representative products in period t-1. For the new product representative, the previous month's price can be estimated with product characteristics that are qualitatively-comparable in both periods (t-1 and t); this can then be directly compared with the observed price in period t of the new product representative and thus provides a measure of the pure price change.

Example for option prices

	Date of observation				
	t – 2	t - 1		t	t + 1
Product m (old)	10	10	$\Delta p_q = 20$	-	-
Product m (new)	-	(30)	$\Delta p_p = 10$	40	50
Index	110.0	110.0		146.7	183.3

This method is applicable if:

- the old and new representative products differ in terms of definable characteristics for which prices can be observed, for example if a new product representative is available that is the same as the old product representative but with additional equipment.

The consequence of using this method is that the value of additional equipment is measured as a quality change, while the rest of the observed change is attributed to a price change.

In practice, the option price method is applied particularly for technical products, for example for quality adjustment of motor vehicles. In motor vehicle manufacturing, a model is frequently updated through the introduction of a replacement model which may have additional features or functions as standard which must be valued separately in order to make the necessary quality adjustment; examples are the addition of side airbags or ABS braking as standard. These additions to the standard equipment of the replacement model must be assigned a price, either by adding a fixed amount (linear change) or by multiplication (percentage change). The value of the addition is different depending on whether it is from the producer's or consumer's point of view, though often it is given its market value due to the difficulty to measure the actual per-unit cost of the quality change.

A difficulty for the option prices method is to assign a value to the additional characteristics. In the case of motor vehicle manufacturing, for instance, it may be possible to value equipment that was offered as an optional extra for the original model. If this is done then it is assumed that the additional price is the same regardless of whether the equipment constitutes standard equipment or an optional extra. In this context it should be noted that the standard installation of equipment may cause the average cost (per item of the equipment) to fall, so that the cost of the equipment as standard cannot be compared with the cost as an optional extra. For this reason it is common for only a part of the additional cost (50 % in many cases) to be assigned as a change in quality.

The use of this method requires a great degree of technical understanding on the part of the staff in the statistical office and intensive contact with the reporting units is indispensable.

Expert estimation

A further possibility of quality adjustment can take place with the aid of expert assessments. The basis for this procedure is formed by the subjective assessment and evaluation of price changes by an expert or group of experts which can subdivide the difference in the observed prices of the old and new representative products into a quality component and a pure price component. This is contingent on the persons concerned having both market and product knowledge in order to be able to determine the pure price change.

With this method, the adjustment of the price is completely dependent on the qualifications, experience and judgement of a person or group of persons, often within the reporting unit. For this reason, it is recommended that the procedure should only be used in narrowly delimitated situations. Experts from reporting units generally attribute a price increase in their own products to improved quality characteristics. Above all, it is important that the market segment concerned is normally not subject to surprising fluctuations which these experts are unable to take into account. This method is contingent on the staff in the statistical office being able to understand the assessments of the experts. Because of the great degree of subjectivity and dependence on particular experts this method should only be used if no other possibilities exist to calculate the pure price change.

Example of expert estimation

	Date of observation				
	t – 2	t – 1		t	t + 1
Product m (old)	10	10	$\Delta p_q = 30$	-	-
Product m (new)	-	(40)		40	50
			$\Delta p_p = 0$		
Index	110.0	110.0		110.0	137.5

This method is applicable if:

- an expert with market and product knowledge is available;
- no other procedure is applicable.

This method relies on a subjective assessment of how much of the observed price change is due to quality change.

Matched model - approach

If the old product representative is replaced by one with different quality and it is not possible to observe both products in the same period, a matched model approach may be used. In order to calculate the pure price change of the new product representative, the price developments of other, similar representative products are used. Depending on the type of product and the number of price observations in the elementary aggregate, these may be similar representative products within the same detailed level of the product classification or from a higher aggregate. It is presumed that the average percentage change of the selected other representative products can serve as a reference for the price change of the new representative product. This presupposes an ideal market in which all producers experience similar price changes.

Example of matched model approach

	Date of Observation				
	t – 2	t – 1		t	t + 1
Product m (old)	10	10	$\Delta p_q = 10$	-	-
Product m (new)	-	(20)		22	23
			$\Delta p_p = 2$		
Elementary index (product m)	105.0	105.0	+ 10.0 %	→ 115.5	120.7
Product n	29	30		33	33
Product o	40	40		44	45
:					
Product w	21	20		22	21
Index (products n to w)	105.0	104.5	+ 10.0 %	115.0	114.2

The calculation of Δp_p is the following:

$$\Delta p_p = P^t_{m(new)} - P^t_{m(new)} \times \frac{I^{t-1}_k}{I^t_k}$$

Δp_p= real price change

$P^t_{m(new)}$ = price of new product representative in the current month

I^{t-1}_k = index of comparable representative products in the previous month

I^t_k = index of comparable representative products in the current month

This method is applicable if:

- adequate numbers of price observations of the same kind of representative products are available.

The consequence of using this method is that an average price change is applied to the product representative whose characteristics have changed.

When using the matched model care must be taken that the representative products being used to calculate the average price change are not subject to any exceptional price fluctuations, for example if a reporting unit operated a special price policy in one or other of the periods. In this way, if any individual representative products (among those selected as 'similar') experienced price developments that were untypical this would also influence the calculation of the estimated price change of the new representative product. As such, the method should only to be applied if a sufficient number of price series for similar representative products are available and have a largely homogeneous price development. Depending on the general price development observed for similar representative products, ten price series (at least) are

appropriate as a basis to ascertain the average percentage price change. If only a small number of price series are available the matched model method should not be used for quality adjustment; alternatively the price change of a higher aggregate would have to be used.

As with the overlap pricing method, the product life cycle of the old and new representative products must be considered. This method should not be used in the case of a representative product sold at a clearance price being replaced by a new representative product sold at full price.

Hedonic approach

Many of the quality adjustment procedures described above have a high degree of subjectivity and are based on different assumptions. The hedonic method decomposes the observed price of a product into its price-determining characteristics with the aid of a mathematical procedure. A key requirement is that the characteristics that influence the price can be identified and measured (valued). A regression model can then be used to estimate the price as a function of the price-determining characteristics and so it is possible to calculate the pure price change to be recorded in individual periods.

In order to measure the pure price change between two periods when there is differing quality, estimated (predicted) prices for the product can be calculated from the regression model. The comparison of the observed price of one representative product with the calculated price in another period forms the basis for the calculation of the price development.

Hedonic approaches provide two mathematical methods to calculate the predicted prices.

- Firstly, imputation can be applied. Here, the price P is calculated by means of a regression model, in which the regression coefficients represent the marginal effect on price of the individual characteristics. These coefficients can be used to estimate the value of a change in the characteristics by comparing the predicted prices.
- It is also possible to use a time dummy approach in calculating the regression model. In this way, the index value for a certain period is ascertained. With this procedure, a regression model is built up which depicts not the price but the price change as a function of the price-determining characteristics and time. The individual regression coefficients for the price-determining characteristics depict the monetary value of the quality change of the individual characteristics; the regression coefficient for time depicts the assessment of the real price change.

Hedonic methods are applied particularly in the cases of types of products which are subject to rapid technological change and with which a reporting unit will therefore have difficulty to report prices for a standard representative product over several periods. The price-determining characteristics must be quantifiable, in other words it must be possible to measure them. The price functions are only estimated values and require constant supervision and improvement. This requires large amounts of high-quality data and makes major demands on staff of the statistical office.

Hedonic methods appear to be objective due to the mathematical portrayal and calculation of the prices and of the indices. However a great number of assumptions and compromises have to be made in order to calculate the price function and this method may not be regarded as an optimum solution for each case of quality adjustment. A large number of observations and calculations are needed in order to reach an authoritative function and the effort and cost involved in hedonic techniques is considerable.

Furthermore the individual price-determining characteristics have to be selected and so these are subjective evaluations of which product characteristics exert an influence on pricing. Equally, the precise sub-division of the characteristics for their evaluation has to be implemented individually.

Methods applied in practice

Summary table of country practices

The methods for quality adjustment described above are used by European countries to a varying extent. The table below gives an overview showing which methods are used in a selection of countries (participating in the PPI task force), and in some cases indicating whether these are used for particular activities/products or different markets.

Quality adjustment methods: frequency of use in practice

Method	Rarely	Sometimes	Often	Very often
Direct price comparison	CZ (domestic) DE ES FR NL FI SE	BG (10, 14, 22.2) SI (+/- 2%)	CZ (11, 27) LT (14)	
Chaining	FI	DE ES PL SI	BG CZ non-domestic: (14) domestic: (all) DK NL	
Overlap pricing	ES	DK NL PL SI	CZ (domestic) FR LT FI	BG DE HU
Matched model approach	DK DE (28) FI (mobile phones)	CZ NL	BG ES	FR
Option prices	ES FR (22.22) LT (26-30) FI	BG CZ DE (29) NL (29) SI (29)	BG (10) CZ (domestic: 28, 29)	
Expert estimation	DE ES	BG CZ (26) NL PL SI FI	LT (13, 14, 16)	UK
Quantity adjustment		LT (10)		
Imputation			CZ (domestic)	
Hedonic	DE (26.11, 26.12, 26.2) FR (26.20.11, 26.20.13, 26.20.14) FI (laptops, desktop computers) UK (30)			

Source: PPI task force

A (modified) matched models method – monthly chaining and resampling in mobile phones, Finland

General features of matching

Index calculation is generally based on binary comparisons, which requires matching the observations or models in two different time periods. As is widely understood, matching keeps the quality constant: a representative product's physical features as well as its sales conditions are held fixed by comparing

similar pairs in time – only the moment of time and the price change. However, in a dynamic economy matching often fails. Therefore the drawback of matching is that the sample may deteriorate and it may lose its representativeness over time.

The basic difficulty collecting prices for mobile phones is the following. For whatever reason the precise same model of phone can not be found in a particular time period (t) as was seen in the base period (time period 0) – typically this period relates to a specific year, or the previous month or December of the previous year. Some models disappear from the market and the quality of models changes and so the original sample size of price observations fall and matching fails. In the case of mobile phones there may be a temptation to keep a model as long as it stays on market, perhaps with minimal sales; while this requires less frequent quality adjustment techniques (which are burdensome) this approach may lead to incorrect results.

Issues related to monthly chaining and resampling

For some products with a rapid technological development statistical offices use a modification of the matched model method called monthly chaining and resampling (MCR). In this method the sample is formed every month, so the sample reflects the structure of the real market in each time period. As an advantage of this solution, the monthly price changes are calculated on the basis of a constantly updated sample and set of weights. In addition, superlative index formulas are often used. The monthly price changes are chained to form an index figure series. But as in a traditional version, only those sampled models that can be found on the market in two consecutive time periods are used in calculations.

Whether the resampling should be done monthly or less frequently is a matter of data sources, the type of product in question and the cost of resampling.

A lot of information is needed and monthly data on the quantities or value produced/sold may be hard to obtain, and so this is an obvious challenge related to this method. As in a traditional matched models approach, only models that are present in two consecutive time periods are used in calculations. As such, it is assumed that the prices of new models and those that have disappeared are developing on average in the same way as the prices of models that stay on the market. In this case the underlying assumption is that the market is perfectly competitive and so no producer has market power, and additionally, pricing strategies remain unchanged.

Of course, the method may be used in different ways. For example only a sub-group of models may be used as a reference group instead of all models and so the average price change is calculated with the help of the models belonging to this sub-group.

Things to consider when using monthly chaining and resampling

There are some limitations to the use of the MCR method and the depth and impact of these restrictions depends on the nature of the product. In the MCR solution models that have disappeared are not taken into account and new models are only taken into account after they have stayed on the market for two consecutive time periods; this is a potential source of error, particularly if there is reason to believe that price changes occur simultaneously with the removal/introduction of models. Only models that can be found in both periods affect the results. It may be argued that in this solution the quality change problem is ignored as on no occasion is any explicit quality adjustment needed. The problem related to models that have disappeared depends on the calculation method: if price change is calculated using average prices then models that disappear are problematic.

The MCR method assumes that the price of new models (and models that have been removed from the market) develop in the same way as the average price development of the models that have stayed on the market. It should be emphasised that this might not be a totally harmless assumption and that the concern is that the information (on prices and quantities) related to new models and those that have disappeared is not used – their price change may differ from existing models. The assumption about perfectly competitive markets may be implausible (or at least remains to be verified). The accuracy and possible errors that may arise from using the MCR method should be carefully studied. Bias may be upward or downward depending on the case.

Pricing strategies and price cycles for old and new models may be different. For example, a new model with a fresh price/quality-combination may be launched to the market with an exceptional price in order to capture extra market share. Furthermore this may stimulate changes in the prices for existing projects that react to the market entry. It might be expected that, when a new mobile phone with a higher price and improved quality is introduced, old models may need to become cheaper to maintain their attractiveness and market share. This may lead to an overestimation of price decline through the MCR method. Furthermore there is the issue of valuing the pure price change of a new (or old) model at the exact time that it emerges (or disappears). Sometimes it is argued that new models' sales are minor at first, and then they gradually grow as price declines. This is a plausible assumption. However, the Finnish experience in mobile phones does not fully confirm that as sales of new models may immediately be huge.

A general presentation of this issue can be made using the example of a new model being introduced which is more advanced technically and therefore its quality has improved. Two situations can be envisaged with respect to its price – it may be i) above the average price of all the other models or ii) below the average price (this second case may be further sub divided). In both cases it is assumed that the price of other mobile phone models are falling (as is generally the case). The hedonic function of time and quality variables defines the regression surface of, for example, logarithmic price. The possible 'movements' in time of these surfaces can be imagined in a two dimensional coordinate system, where logarithmic price is on the y-axis and a quality vector on the x-axis.

- In the first case, if the prices of models that exist on the market stay unchanged, and a new, more expensive one emerges, the surface shifts upward. When considering only the old models, the surface goes downwards, because their prices were declining. But as the new model shifts the surface, as it is a more expensive and better quality phone, eventually the surface should be lower down, but not as low as it would have been without the new model. Therefore it may be concluded that in this case the matched model method overestimates the pure price change. Of course, this depends on the significance of the new observation, as well as the behaviour of any previous observations that disappear.
- In the second case, there are two possibilities. Following the same kind of reasoning as above, it may be concluded that i) when a new model's price is above the declining average price of other models, the matched model method is overestimating the pure price change (the surface should not fall that much) and ii) when a new model's price is below the average price, the matched model method is underestimating the pure price change (the surface is not low enough).

Sometimes critics of using MCR in mobile phones argue that the price index is declining too fast, because the pure price change related to a new model's introduction period may be totally different from price development of old models. The same is true for passenger cars: some pure price change may be attached to the moment when a new model is introduced. However, estimating this period's price change with the help of models that existed on the market and that typically have stabile prices may very often lead to no pure price change being recorded.

Whether or not MCR gives a proper estimate of monthly price change depends, among other things, on the issues described above. A comprehensive study concerning the differences in results obtained, for example with hedonics, classification and unit values and matched models methods, including MCR would be interesting. While hedonics uses cross section data and takes advantage of all models available at any one time it also has limitations; it is challenging to include in the regression model new models with totally new characteristics. An alternative might be to use a classification of phones and calculate unit values as this provides the possibility of using the information that is currently lost, such as the prices of new models; this would of course introduce the difficulties associated with unit values.

An example of matched model approach for mobile phones

The method described below is a monthly chaining and resampling method, where monthly price changes are chained to form an index figure series. The monthly data contains average prices and quantities for a selection (n) of top selling models, so the sample here has a cut off. The coverage is assumed to be rather high, even though not every sold model is present in the data set. Only models with minor sales are absent, and in terms of the total quantities sold, the coverage is regarded as good.

For each pair of consecutive time periods only those models that are present in both periods are used in calculations. Information related to new models and those that have disappeared is not taken into account. Explicit quality adjustment methods are not implemented. Laspeyres, Paasche and Fischer indices are calculated. Then the previous month's index figure, for example for mobile phones (for the domestic market) is chained forward with the price change obtained from Fischer index. The same procedure may be carried out for the non-domestic market as well and these subindices combined to produce the total producer price index.

The example below illustrates the method using imaginary data: in reality there are changes in average prices and quantities. Because of the fictive nature of the data this example does not serve to illustrate the similarities or differences in results that may occur from various possible calculation methods.

Example data for mobile phones

Time period	0		1		2		3	
Variable	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity
Model 1	90	140	75	120	65	60		
Model 1+					90	130	85	120
Model 2	120	170	100	190	95	135	80	160
Model 3	250	80	220	65	210	70	200	65
Model 4							300	50

Results given by different index formulas

Between periods 0 and 1	Between periods 1 and 2	Between periods 2 and 3
$Ind\_Las_0^1 = sum(Pi^1Qi^0)/sum(Pi^0Qi^0) = 0.8509$	$Ind\_Las_1^2 = 0.9338$	$Ind\_Las_2^3 = 0.9140$
$Ind\_Paa_0^1 = sum(Pi^1Qi^1)/sum(Pi^0Qi^1) = 0.8485$	$Ind\_Paa_1^2 = 0.9409$	$Ind\_Paa_2^3 = 0.9079$
$Ind\_Fis_0^1 = Ind\_Las_0^1 * Ind\_Paa_0^1)^{(1/2)} = 0.8497$	$Ind\_Fis_1^2 = 0.9373$	$Ind\_Fis_2^3 = 0.9109$

Index levels based on Fischer index and chaining

Time period	0	1	2	3
Index	100.00	84.97	79.64	72.55

In this example there are three different mobile phone models in the market in a time period 0. The model selection stays unchanged in time period 1 – only prices and sales quantities change. First Laspeyres, Paasche, and Fischer indices are calculated using the prices and quantities of Model 1, Model 2 and Model 3. The Fischer index shows a price change between time periods 0 and 1 of 0.8497, which means that the prices have declined by 15.03 %. As the index level for mobile phones in time period 0 is 100, it follows from the chaining principle that the index for mobile phones in time period 1 is 84.97.

A change occurs in the market in time period 2. A new, updated version of model 1 is launched and is reflected in the example as model 1+; it immediately has a great sales volume. Its predecessor, model 1, still exists on the market. The monthly price change is still estimated on the basis of models 1, 2 and 3. As can be seen from the second table the prices declined by 6.27 % between time periods 1 and 2. By following the chaining technique the index level for time period 2 is 79.64 (=0.9373*84.97).

More changes take place in time period 3. First of all, Model 1 disappears from the market. Secondly, a new model has emerged, for example wit ha new technology – shown as model 4. The monthly price change is calculated on the basis of models 1+, 2 and 3, because they have been available on the market for two consecutive periods. The price change between periods 2 and 3 is -8.91 % according to the Fischer index. Thus the index level for period 3 is 72.55 (=0.9109*79.64).

With traditional index compilation methods there is a challenge in price monitoring in time period 3. Model 1 has disappeared from the market and would have to be replaced. Depending on the sampling strategy, model 1+ or model 4 would be selected as the replacement. The use of the overlapping method is a possible solution only with model 1+. Naturally other quality adjustment methods hold for both models.

Some statistical offices have found quality adjustment methods quite difficult to use in products with such rapid technological developments like mobile phones. Quality is constantly developing and prices of models decline after being introduced to the market. The price of a new model may be higher than a previous model's price was when it was launched. In these circumstances it is a rather challenging task to evaluate the pure price change using simple and feasible quality adjustment methods. As a simple, but hopefully illustrative example, it can be imagined that model 1 disappears from the market in time period 2. In this situation model 1 is replaced with model 1+. The last recorded price for model 1 was 75 (having started at 90). The price for model 1+ is 90. So there is a relatively large price difference between these two models. In addition, some new technical features are included in model 1+. Estimating the pure price change between these two models is not a trivial task. A comprehensive study should provide information whether or not the MCR method gives 'exact enough' results or whether there is a substantial error in a particular direction.

Hedonic approach on the example of computers, United Kingdom

The identification and valuation of changes in the quality of high-tech products such as computers is one of the most challenging issues faced in the production of price indices. Quality improvements are frequently observed and the same model is rarely available for longer than a few months. When an item is replaced by another item which is deemed to be of different quality, there is a wide array of options available to deal with the change in quality, ranging from ignoring any change in quality and making a direct comparison, to adjusting the observed price to take account of the change in quality which has occurred, including hedonic quality adjustment.

Hedonic quality adjustment methods have been successfully implemented by a number of national statistical offices. The main advantages of this method are that the base price of a new product representative is predicted from its individual characteristics and it is effective when there are a large number of non-comparable replacements. As a side effect, by indicating which product attributes do not impact on the price, hedonic methods may also improve the identification of comparable items.

This procedure can be used to create hedonic functions for producer or consumer prices with the key difference between the application of the methods being the inclusion / exclusion of taxes such as VAT.

The following section deals with the United Kingdom's use of hedonic re-pricing for notebook and desktop computers.

Identification of products

High technology products are often imported into the United Kingdom and the data from United Kingdom manufacturers do not form a large enough sample that is required to estimate a sufficient model to calculate the hedonic indexes for producer price indices. To obtain a reasonable sample, it is necessary to use the same regression sample used for the consumer price index. This assumes that the prices for United Kingdom producers of computers are determined by prices set by the global market and imported products. Therefore, the value of quality change determined by the regression sample is assumed to be the same for United Kingdom manufacturers as is for imported products.

Manufacturers of high technology products are selected using random selection. This involves selecting units from the United Kingdom business register using PPS. When a business is selected, a recruitment questionnaire asks the producer to select a representative product that they manufacture in order to quote a price for each period. This uses an expert judgement approach assuming that the manufacturer has the best understanding of what is the most representative item. When the product is replaced the manufacturer is asked to describe the changes in characteristics.

Constructing a target sample

For the application of hedonic re-pricing, two samples have to be collected. The first sample is called the 'regression sample' which serves for the calculation of the hedonic regression equation. The second sample is called the 'index sample' and is used to calculate the price index. These two samples need to be collected for each type of product (in this case desktops and notebooks) separately.

If it is possible to collect a sufficient regression sample every month then there is no reason to compile a separate index sample. In this case, the regression sample can also be used as index sample. In the United Kingdom, currently there are insufficient resources to collect the minimum regression sample every month. The regression sample is collected quarterly and is applied to a smaller index sample collected monthly.

The regression sample

The regression sample is needed for the calculation of a systematic relationship between the prices of the desktops and notebooks respectively and their particular characteristics. Resulting from this relationship the hedonic equation can be established.

The regression sample can be collected according to the same procedure as the regular index sample: in fact the index sample may also be a subsample of the regression sample or it can be independent from the regression sample.

The characteristics relevant to quality are assumed to be the same from a producer and consumer point of view. For example, an increase in memory will be a quality improvement for both a consumer and producer. A large number of characteristics are collected which are identified from a variety of sources including computer experts, computer magazines, computer specifications and other research.

It is important not to consider variables that reflect fashion, for example the colour of a notebook.

The following characteristics may serve as orientation for desktops:

- brand (e.g. Dell, LG, none, …);
- processor type (e.g. Intel Pentium xx, AMD xx, …);
- processor speed (in GHz);
- hard-disk drive capacity, abbreviated: HDD (in GB);
- working memory, abbreviated: RAM (in GB);
- operating system (Windows (version), Linux, none, …);
- other software (Microsoft Office, …);
- type of drive (CD-rewriter, DVD player/rewriter, …);
- graphical card;
- …

The above mentioned characteristics only serve as orientation. More variables may be important, such as soundcards or TV cards which may be included in the desktop computer.

For notebooks, the size, type of the display and weight are some of the most price-determining characteristics. Therefore, the following characteristics may serve as orientation for notebooks:

- type of display (SVGA, VGA, …);
- size of the display;
- brand (e.g. Dell, LG, none, …);
- processor type (e.g. Intel Pentium xx, AMD xx, …);
- processor speed (in GHz);
- hard-disk drive capacity, abbreviated: HDD (in GB);
- working memory, abbreviated: RAM (in GB);
- operating system (Windows (version), Linux, none, …);
- other software (Microsoft Office, …);

- type of drive (CD-rewriter, DVD player/rewriter, …);
- graphical card.

Given the rapid technological change of computers, new features are included with certain regularity. This is not so frequent that it would be necessary to select a new set of relevant characteristics every month, but the staff of the statistical office should be aware of the possibility and review the type of characteristics to model at least once a year.

Whenever a new characteristic (for example a new kind of processor or a new drive) is introduced, a judgement should be made whether the new characteristic is important enough to be included. Therefore, a continuous market observation is necessary which may include talking with experts and researching (in computer magazines or on websites).

However, new characteristics can only be used to adjust for quality differences if this characteristic is collected in both the price reference month and the current month.

Minimum size of the target sample

The regression samples should contain 100 to 300 observations for each index, depending on the number of characteristics that are used in the regression equation. As a rule of thumb, 15 to 20 observations should be collected for each characteristic which is finally included in the regression equation.

The index sample is considerably smaller but does require at least 20 price observations for each index every month to ensure a representative price index.

Ideally, the data collection should be high quality price and characteristic data obtained directly from the producer or retailer. However, generally the data for the regression sample is collected manually which is labour intensive and time consuming. The data for the index sample is collected directly from manufacturers but requires manual intervention to ensure the full set of price and characteristic data is included. The data needs to go through a series of quality control steps: data collection and cleaning steps constitute approximately one week's work.

Calculating the regression model

The regression process is carried out by modelling the predicted price (included as the natural log of the price) as a function of the characteristics collected. This regression model is carried out using the SAS regression procedure. Selection of the variables to include in the final model involves a combination of automatic iterative procedures and expert review of the model. The automatic procedure removes variables sequentially that only make a small contribution ('initial backwards stepwise regression'). The model is then reviewed (by a statistical officer) to ensure there is no multicolinearity, the residuals are reviewed to identify outliers and the direction and size of the coefficients are reviewed to ensure they make sense. This function is then implemented in index calculations to determine the base price of items.

The hedonic regression could look like this:

$$\ln p = b_o + b_1 \cdot brand\_a + b_2 \cdot brand\_b + b_3 \cdot processor\_CEL + b_4 \cdot processor\_DUAL + b_5 \cdot processor\_speed + b_6 \cdot RAM + b_7 \cdot HDD + \varepsilon$$

In the United Kingdom, the regression model is generally calculated once a quarter and used to adjust for quality change each month. If there has been a new characteristic introduced in the index sample but is not in the regression sample then additional data are required and a new regression model is calculated.

This procedure is used to create hedonic functions for either the PPI or the consumer prices index (CPI); the only difference is the inclusion / exclusion of taxes on the dependant variable, the natural log of price.

Calculating the price index

Each month, price and characteristic information in the index sample are obtained. Where there has been no change in characteristics the direct observed price change is recorded. Where there has been a change in characteristics from the previous period to the current period, the hedonic model is used to estimate the

value of the change which is then applied to the base period price. The application of this is shown below.

Step 1: Collect regression sample and express price (p) of each item as a function of its characteristics $C = (c_1, c_2, c_3, ...)$ such that

$$\ln p = b_o + b_1 \cdot c_1 + b_2 \cdot c_2 + b_3 \cdot c_3 + ... + \varepsilon$$

Step 2: Use the regression model to estimate price as a function of the characteristics

$$\hat{p}_C^t = \exp(\hat{b}_o + \hat{b}_1 \cdot c_1 + \hat{b}_2 \cdot c_2 + \hat{b}_3 \cdot c_3 + ...) = h(c_1, c_2, c_3, ...)$$

Step 3: Where there has been a change in characteristics in the index sample, use the estimated function to predict the price of both the OLD and the NEW qualities

$$\hat{p}_{C-OLD}^t = h(c_{1-OLD}, c_{2-OLD}, c_{3-OLD}, ...)$$
$$\hat{p}_{C-NEW}^t = h(c_{1-NEW}, c_{2-NEW}, c_{3-NEW}, ...)$$

Step 4: Use the ratio of the predicted price to determine a period 0 (base period) price for the new quality.

$$g = \frac{\hat{p}_{C-NEW}^t}{\hat{p}_{C-OLD}^t} = \frac{h(c_{1-NEW}, c_{2-NEW}, c_{3-NEW}, ...)}{h(c_{1-OLD}, c_{2-OLD}, c_{3-OLD}, ...)}$$

$$\hat{p}_{C-NEW}^0 = g \times p_{C-OLD}^0$$
$$= p_{C-OLD}^0 \times \frac{h(c_{1-NEW}, c_{2-NEW}, c_{3-NEW}, ...)}{h(c_{1-OLD}, c_{2-OLD}, c_{3-OLD}, ...)}$$

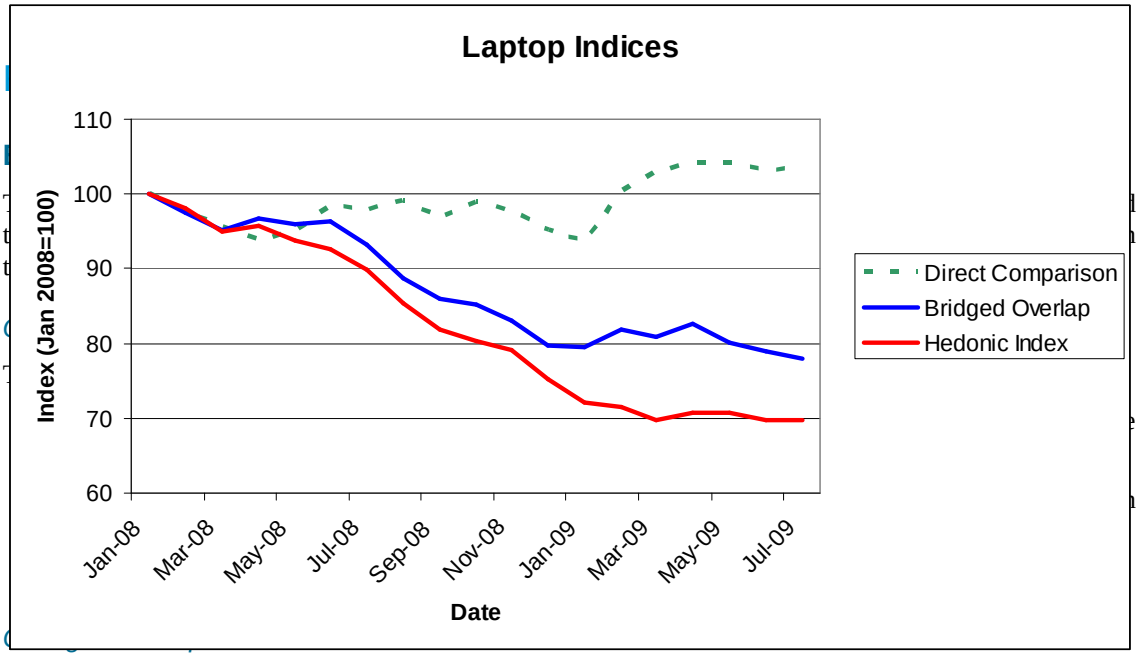
Step 5: Use the new base period price to compare to the current period price to give the pure price change.

$$\Delta P^{0:t} = \frac{p_{C-NEW}^t}{\hat{p}_{C-NEW}^0}$$

Analysis of the final index

The final index is a combination of the observed price change and the quality adjustments applied by the hedonic model. In order to review the index each period the index is also calculated using the bridged overlap method for comparison. Comparing the index change between the bridged overlap and the hedonic methods allows the compiler to analyse the net effect of the hedonic model quality adjustments over the remainder of the sample. Comparisons with the average or direct price index should not be made as it includes both price and quality change.

Final price index for laptops – comparison of methods



A change of product is defined as when product i' replaces product i, both being representative of the same family of products but being sufficiently different to distinguish them one from the other from an economic point of view. The price level of products i and i' is such that they should in theory offer the buyer the same service in terms of utility. In practice, a change of product/service becomes known if the observation unit (the producer) advises the statistical office of the fact, or if the price seems to change too much (or too little) for the activity in question.

The variation in price between $p_i^{(t-1)}$ and $p_{i'}^{(t)}$ results from the difference between the two in nature, composition, market positioning and so on. A breakdown of the change between $p_i^{(t-1)}$ and $p_{i'}^{(t)}$ must therefore be made, with one component, the 'quality effect' measuring the price change attributable to changes in the product and a second 'pure price' component. Market prices do not always properly reflect quality differences. The closer the market for a product is to perfect competition the better the quality evaluation from market prices. As such the appropriateness of a particular method depends in part on the characteristics of the market for the product.

The Handbook on price and volume measures in national accounts proposes the following measures for accounting for quality changes in price indices. If products i and i' coexist at the time of replacement in period t:

- overlap (or market) approach - the price difference recorded on the market measures the quality effect. In this case, product i alone figures in the computation of the index up to the reference period t and product i' in the computation of the index for reference period t+1 onwards;
- unadjusted price comparison (or direct price comparison) - the price difference recorded on the market measures the pure-price component and it is assumed that there is no quality change
- automatic linking (or link-to-show-no-price-change) - the products i and i' are regarded as non-comparable and the price level is considered to be unchanged; the price difference recorded on the market is assumed to measure the quality effect; this gives a similar result to the overlap approach but it can also be used whether or not the products i and i' coexist at the time of replacement in period t;
- option prices - if the difference between products i and i' is the inclusion of an extra option this option can be valued at its price if purchased separately and this used to derive an estimate of the

price or the product without the option; care has to be taken with the estimation as separately purchased options may however be more or less expensive than bundled options;

- production costs (or manufacturer) approach – the quality effect is represented by the difference in manufacturing costs (production costs) between the two products at time t; this method can be improved by not only looking at differences in production costs but also producers' profit margins that should also be reflected in producers' prices.

Estimate the price of product/service i at time t or the price of product i' at time t-1:

- matched models only (imputation or imputed price change-implicit quality adjustment) - estimate the price change of product i (more often than not) from the mean price change of similar products between t-1 and t which themselves are unchanged - however these may well differ from the price change of the new product; note that this can be done whether or not the products i and i' coexist at the time of replacement in period t;
- judgmental approach - subjective estimates may be made by the observation unit or an analyst with specialist knowledge using an overlap price or production costs method
- by a hedonic econometric method. It assumes that the price of products of different qualities will depend on measurable characteristics. From a large number of observations of market prices and characteristics of various models a regression is carried out to investigate which characteristics are the determinants of price differences between the models. Either i) implicit prices of each characteristic are estimated and applied to predict the price of products offering the same characteristics but absent from the market at time t-1 or ii) a price index is directly calculated from the regression. This method requires not only special processing and expertise but also a substantial volume of data, which can prove difficult to bring together in a recurrent data production process. The method is recommended for products whose technological development is very rapid, such as computer hardware.

Non-domestic-price indices - changes in the product/service

Any product change must be quantified in terms of pure price development. In the case of products monitored on the non-domestic market, the additional destination factor can also lead to a change in product external to all the other characteristics of the selected product/service.

When a product i' replaces product i, both should be representative of the same family of products, and thus of the same (group of) destination. A change in price between the two products i and i' may be due to no more than a change in the product's destination. For this reason, every effort must be made to quantify the pure price effect of this change of destination.

IMF-Recommendations

The following recommendations are extracted from the revised draft chapter 7 of the IMF manual on PPIs.

'Methods for making quality adjustments

7.73 When a product is missing in a month for reasons other than being off-season or off-cycle, the replacement may be of a different quality—the price basis may have changed, and one may no longer be comparing like with like. A number of approaches exist for dealing with such situations and are well documented for the CPI, ... Though the terms differ among authors and statistical agencies, they include

- Imputation — When no information is available to allow reasonable estimates to be made of the effect on price of a quality change. The price change of all products—or of more or less similar products—are assumed to be the same as that for the missing product.
- Overlap — Used when no information is available to allow reasonable estimates to be made of the effect on price of a quality change but a replacement product exists in the same period as the old product. The price difference between the old product and its replacement in the same overlap period is then used as a measure of the quality difference.

- Direct comparison — If another product is directly comparable, that is, so similar it has more or less the same quality characteristics as the missing one, its price replaces the unavailable price. Any difference in price level between the new and old is assumed to be because of price changes and not quality differences.
- Explicit quality adjustment — When there is a substantial difference in the quality of the old and replacement products, estimates of the effect of quality differences on prices are made to en-able quality-adjusted price comparisons.

7.74 Before outlining and evaluating these methods, one should say something about the extent of the problem. This situation arises when the product is unavailable. It is not just a problem when comparable products are unavailable, for the judgment as to what is and what is not comparable itself requires an estimate of quality differences. Part of the purpose of a statistical meta information system for statistical offices […] is to identify and monitor the sectors that are prone to such replacements and determine whether the replacements used really are comparable.

7.75 Quality adjustment methods for prices are generally classified into the implicit or imputed (in-direct) methods explained in Section D (the differences in terminology are notorious in this area) and explicit (direct) methods explained in Section E. Both decompose the price change between the old product and its replacement into quality and pure price changes. However, in the latter, an explicit estimate is made of the quality difference, usually on the basis of external information. The pure price effect is identified as a remainder. For implicit adjustments, a measurement technique is used to compare the old product with the replacement, so that the extent of the quality and pure price change is implicitly determined by the assumptions of the method. The accuracy of the method relies on the veracity of the assumptions, not the quality of the explicit estimate. In Sections D and E, the following methods are considered in detail:

Implicit methods:

- Overlap;
- Overall-mean/targeted mean imputation;
- Class-mean imputation;
- Comparable replacement;
- Linked to show no price change; and
- Carry-forward.

Explicit methods:

- Expert judgment;
- Quantity adjustment;
- Differences in production/option costs; and
- Hedonic approach.

Choosing a Quality Adjustment Method

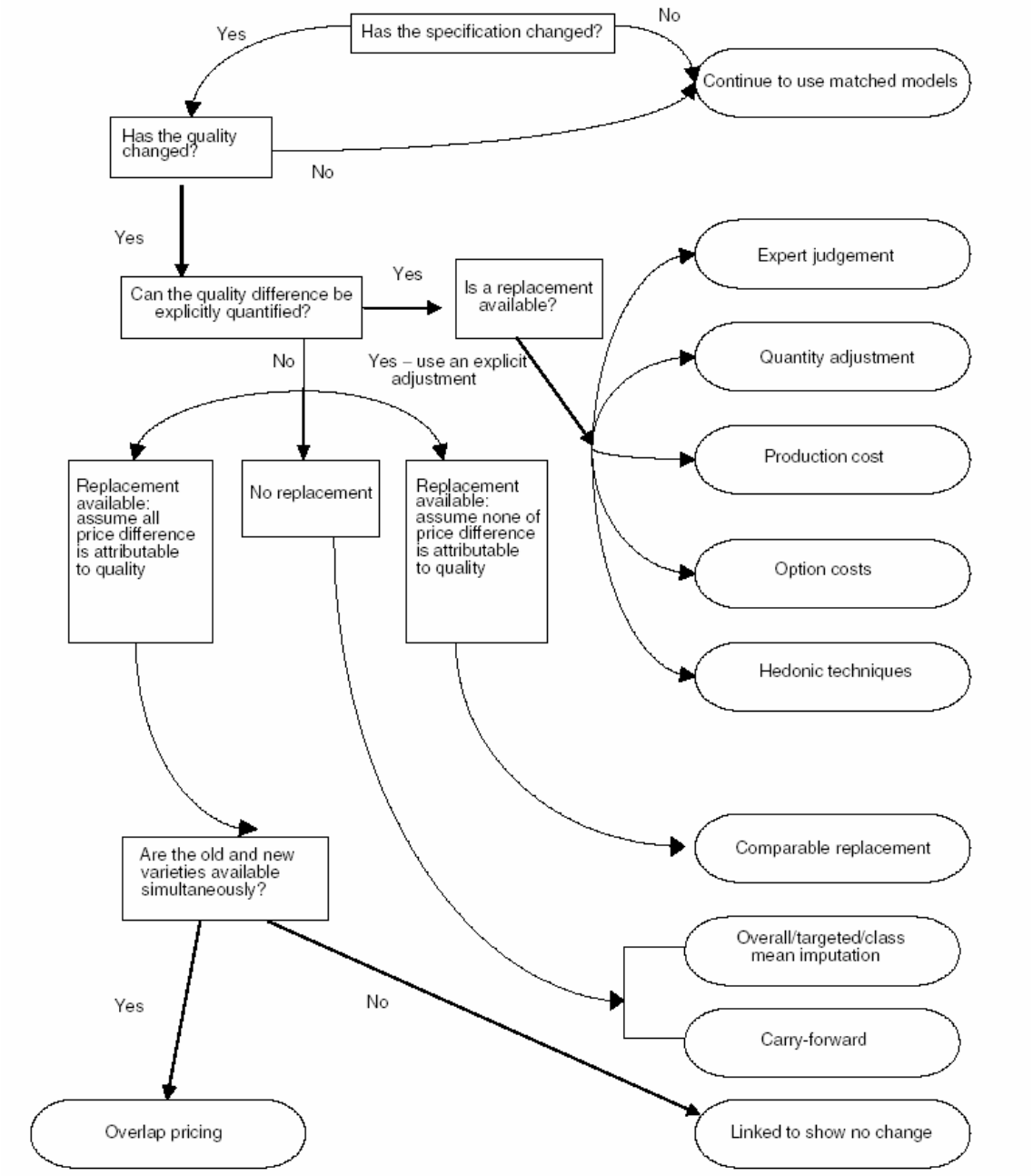
7.152 Choosing a method for quality-adjusting prices is not straightforward. The analyst must consider the technology and market for each commodity [product] and devise appropriate methods. This is not to say the methods selected for one industry will be independent of those selected for other industries. Expertise built up using one method may encourage its use elsewhere, and intensive use of resources for one commodity [product] may lead to less resource-intensive methods in others. The methods adopted for individual industries may vary among countries as access to data, relationships with the respondents, resources, expertise and features of the production, and market for the product vary. Guidelines on choosing a method arise directly from the features of the methods outlined above. A good understanding of the methods and their implicit and explicit assumptions is essential when choosing a method.

7.153 Consider Figure 7.3, which provides a useful guide to the decision-making process. Assume the matched-models method is being used. If the product is matched for repricing – without a change in the specification – no quality adjustment is required. This is the simplest of procedures. However, a caveat applies. If the product belongs to a high-technology industry where model replacement is rapid, the matched sample may become unrepresentative of the universe of transactions. Alternatively, matching may be under a chained framework, where prices of products in a period are matched to those in the preceding period to form a link. A series of successive links of matched comparisons combined by successive multiplication makes up the chained matched index. Alternatively, hedonic indices may be used, which require no matching. The use of such methods is discussed in Section G. At the very least, attention should be directed to more regular product resampling. Continued long-run matching would deplete the sample, and an alternative framework to long-run matching would be required.

7.154 Consider a change in the quality of a product, and assume a replacement product is available. The selection of a comparable product to the same specification and the use of its price as a comparable replacement require that none of the price difference is due to quality. They also require confidence that all price-determining factors are included on the specification. The replacement product should also be representative and account for a reasonable proportion of sales. Caution is required when nearly obsolete products at the end of their life cycles are replaced with unusual pricing by similar products that account for relatively low sales, or with products that have substantial sales but are at different points in their cycle. Strategies for ameliorating such effects are discussed below and in Chapter 8 [of the IMF manual on PPIs], including early substitutions before pricing strategies become dissimilar.

7.155 [The] Figure [below] shows where quality differences can be quantified. Explicit estimates are generally considered to be more reliable, but they are also more resource intensive (at least initially). Once an appropriate methodology has been developed, explicit estimates can often be easily replicated. General guidelines are more difficult here since the choice depends on the host of factors discussed above, which are likely to make the estimates more reliable in each situation. Central to all of this is the quality of the data on which the estimates are based. If reliable data are unavailable, subjective judgments may be used. Product differences are often quite technical and very difficult to specify and quantify. The reliability of the method depends on the knowledge of the experts and the variance in opinions. Estimates based on objective data are, as a result, preferred. Good production cost estimates, along with good data on mark-ups and indirect taxes in industries with stable technologies where differences between the old and replacement products are well specified and exhaustive, are reliable by definition. The option cost approach is generally preferable when old and new products differ by easily identifiable characteristics that have once been separately priced as options. The use of hedonic regressions for partial patching is most appropriate where data on price and characteristics are available for a range of models and where the characteristics are found to predict and explain price variability well in terms of a priori reasoning and econometrics. Use of hedonic regressions is appropriate where the cost of an option or change in characteristics cannot be separately identified and has to be gleaned from the prices of products sold with different specifications in the market. The estimated regression coefficients are the estimate of the contribution to price of a unit change in a characteristic, having controlled for the effects of variations in the quantities of other characteristics.

Flowchart for Making Decisions on Quality Change



Source: Chart based on work of Fenella Maitland-Smith and Rachel Bevan, OECD; see also a version in Triplett (2002).

7.156 The estimates are particularly useful for valuing changes in the quality of a product when only a given set of characteristics change, and the valuation is required for changes in these characteristics only. The results from hedonic regressions may be used to target the salient characteristics for product selection. The synergy between the selection of prices according to characteristics defined as price-determining by the hedonic regression and the subsequent use of hedonics for quality adjustment should reap rewards. The method should be applied where there are high ratios of non-comparable replacements and where the differences between the old and new products can be well defined by a large number of characteristics.

7.157 If explicit estimates of quality are unavailable and no replacement products are deemed appropriate, then imputations may be used. The use of imputations has much to commend it in terms of resources. It is relatively easy to employ, although some verification of the validity of the implicit assumptions might be appropriate. It requires no judgment (unless targeted) and is therefore objective. Targeted mean imputation is preferred to overall mean imputation as long as the sample size on which the target is based is adequate. Class mean imputation is preferred when models at the start of their life cycles are replacing those near the end of their life cycles, although the approach requires faith in the adequacy of the explicit and comparable replacements being made.

7.158 Bias from using imputation is directly related to the proportion of missing products and the difference between quality-adjusted prices of available matched products and the quality-adjusted prices of unavailable ones […]. The nature and extent of the bias depends on whether short-run or long-run imputations are being used (the former being preferred) and on market conditions (see Section H). Imputation in practical terms produces the same result as deletion of the product, and the inclusion of imputed prices may give the illusion of larger sample sizes. Imputation is less likely to give bias for products where the proportion of missing prices is low. Table 7.2 [in the IMF manual on PPIs] can be used to estimate likely error margins arising from its use, and a judgment can be made as to whether they are acceptable. Its use across many industries need not compound the errors since, as noted in the discussion of this method, the direction of bias need not be systematic. It is cost-effective for industries with large numbers of missing products because of its ease of use. But the underlying assumptions required must be carefully considered if widely used. Imputation should by no means be the overall, catchall strategy, and statistical agencies are advised against its use as a default device without due consideration to the nature of the markets, possibility of targeting the imputation, and the viability of estimates from the sample sizes involved if such targeting is employed.

7.159 If the old and replacement products are available simultaneously and the quality difference cannot be quantified, an implicit approach can be used whereby the price difference between the old and replacement product in a period in which they both exist is assumed to be due to quality. This overlap method, by replacing the old product with a new one, takes the ratio of prices in a period to be a measure of their quality difference. It is implicitly used when new samples of products are taken. The assumption of relative prices equating to quality differences at the time of the splice is unlikely to hold true if the old and replacement products are at different stages in their life cycles and different pricing strategies are used at these stages. For example, there may be deep discounting of the old product to clear inventories and price skimming of market segments that will purchase new models at relatively high prices. As with comparable replacements, early substitutions are advised so that the overlap is at a time when products are at similar stages in their life cycles.

7.160 The use of the linked to show no change method and the carry-forward method is not generally advised for making quality adjustment imputations for the reasons discussed unless there is deemed to be some validity to the implicit assumptions.'

CENEX recommendations

The following recommendations are taken from the CENEX ([3]) Handbook on the application of quality adjustment methods on cars and computers in the harmonised index of consumer prices (HICP), published in September 2009. In principle, the HICP recommendations for cars and computers could also apply to PPIs but the difficulty is to distinguish between what is manufacturing and what is assembly and trade for the purposes of the PPI. The HICP guidelines and examples below may prove useful also for the quality adjustment of the PPI. Editor's note: the style and terminology of the extract below has been edited in places to follow more closely the standards applied elsewhere in this handbook.

([3]) Centers and networks of excellence.

Cars

In the case of new cars, minor changes constitute changes in the equipment of an essentially equivalent model which can be adjusted explicitly. Major changes in the quality of new cars are too complex for an explicit quality adjustment. They refer to complex technological modifications. In these cases an implicit method is applied.

Quality adjustment in the case of minor changes: option pricing

Option pricing should be applied whenever it is possible.

For the application of option pricing it is important that the considered equipment items were already available as options prior to the inclusion into the standard equipment package. A description of the calculation of a quality adjusted price when applying option pricing can be found in the first chapter of the [CENEX] handbook. The price of the new model is adjusted for 50 % of the value of the changed equipment that was observable as an option in the previous period. The 50 % rule is confirmed by the HICP standards on cars.

There are two cases where option pricing should be applied even though no particular option price is available. In these cases indirect option prices are calculated.

- A change in the fuel consumption of a car.
- A change in the engine power of a car.

The option prices should ideally stem from the particular manufacturer for the particular primary model (from the previous period). If such an option price is not available option price lists of alternative brands for similar primary models from the same consumption segments could also be used.

Quality adjustment in the case of major changes: bridged overlap

In the case of major changes in quality, no explicit quality adjustment is possible since the replaced and the replacement product are in principle not comparable at all.

If major quality changes occur, bridged overlap shall be applied. The price development of all other models of the same consumption segment which were not replaced build the bridge between the replaced and the replacement model. In this way the average price development of a set of comparable models is used.

Computers

The task force on quality adjustment and sampling rated hedonics as an A-method. In addition, 100 % option pricing (for desktops), supported judgement as a proxy to 100 % option pricing, and bridged overlap (applied under certain conditions) were assessed as B-methods.

The empirical studies of the CENEX members showed that hedonic re-pricing is more suitable than bridged overlap for desktop computers, whereas both methods yield similar results for notebooks. Furthermore, the empirical studies showed some difficulties regarding the application of 100 % option pricing for both desktops and notebooks.

Proposal for the quality adjustment: bridged overlap (notebooks only)

Matched models can be directly compared.

If an old model is replaced by a new one bridged overlap shall be applied. The price development of all other (matched) notebooks is used as the bridge.

In order to adjust for the quality change between replaced and replacement model the price development of all other observed models is used as bridge (see below).

Proposal for the quality adjustment: option pricing (desktops only)

For most products, option pricing is used when a certain feature of a product, like air conditioning in a

car, used to be an option but has now become standard. Hence the name 'option pricing'. For computers, it is used in a slightly different way. Here, option pricing is used to adjust for the price differences of a certain feature, when a new product (replacement model) has a different variant of that feature than the old product (original, replaced model). For example, when the replacement model has a hard disk of 200 GB and the original model one of 100 GB, option pricing adjusts for the price difference of these hard disks.

The following characteristics are suggested for observation:

- Processor type (e.g. Celeron, Pentium xx, …)
- Processor speed (in MHz)
- Hard disk capacity (in MB/GB)
- Working memory (in MB/GB)
- Operating system (Windows (version), Linux, none, …)
- Other software (Microsoft Office, …)
- Type of monitor, including size (TFT or not, …)
- Type of drive (CD-rewriter, DVD player/rewriter, …)

If a model can be observed in two subsequent periods (matched model) the prices of the previous and the current period can be directly compared.

If a change in one of the characteristics (listed above) occurs option pricing shall be applied. For desktops, 100 % option pricing is suggested.

For option pricing, information is needed on three aspects:

- to link specific original models with specific replacement models; replacement models are called successors in this case;
- to know the differences between original models and their successors, both qualitatively and quantitatively;
- to know the option prices of these particular differences.

Given this information, the quality-adjusted price of either the original models or the successors can be calculated. For products with a high rate of turnover, like computers, the statistical office generally does not known in advance when a model will be replaced. In practice, option prices can then only be collected in the period when the successor is introduced. It is possible to adjust the price of the original model as well as to adjust the price of the replacement model with regards to the same option prices.

Therefore:

	Observed price of the replacement
+	Option prices of the characteristics in which the original model differs from the replacement
-	Option prices of these characteristics of the replacement
=	Quality adjusted price of the replacement

Drawbacks of 100 % option pricing for desktops

The empirical study on computers conducted within the scope of the CENEX project did not necessarily yield reliable results for option pricing.

There are several other problems with option pricing.

- It is necessary to be able to determine in which respects the original and the replacement differ.
- A monetary value of the characteristics in which these models differ from each other is required. With option pricing an explicit choice is made to collect additional prices to determine these values and this places a huge burden on data collection, as information is needed not only on prices and characteristics of the models in the sample, but also on the prices of these characteristics.
- The biggest problem with the option pricing method is the lack of certainty that the option prices correctly reflect the price differences of these characteristics when sold as part of a computer as opposed to bought separately. Moreover, for some characteristics it will not be possible at all to collect these separate prices. Especially for original models, the option prices may not be available because the particular options are not available anymore.
- Since information on the reliability of the additional option prices is not available it cannot be assumed that option pricing leads to a reliable quality adjustment in the case of computers. In this case an implicit quality-adjustment method like the bridged overlap method may result in an index that is as good as an index that was quality-adjusted using option pricing.

Proposal for the quality adjustment: hedonic re-pricing (desktops and notebooks)

For the application of hedonic re-pricing it may be necessary to collect two data sets for each family of products (in this case desktops and notebooks). That means that there is one regression sample and one index sample for desktops, and one regression sample and one index sample for notebooks. If a regression is carried out monthly the regression sample and the respective index sample may be identical. In order to calculate the hedonic equation a comprehensive database is necessary which is called ‘regression sample’. The hedonic equation is used to apply quality adjustment in the case of replacement situations which can only occur in the index sample.

V

Index compilation and revisions

Chapter 8 Index compilation

Introduction

The focus of this chapter concerns the chaining technique for the index compilation - an annex provides an example on the decomposition of the chained index rate of change.

Mainly, PPIs are calculated in three stages, depending on their aggregation level. The stepwise compilation procedure implies the aggregation of the lower-level indices to obtain the higher levels ones, up to the overall index. This technique is consistent in aggregation because it should grant (apart from rounding issues) the same result as if the total index had been compiled in one step. The first step in compiling indices concerns price relatives. Each price relative is the quotient of the ratio between the current monthly price (numerator) and the base price (denominator). In a second step price relatives are aggregated to obtain the elementary price index, also known in the PPI context as the elementary product index. In the third and final step the elementary product indices are aggregated as weighted averages (typically as a Laspeyres-type index) to provide a set of synthetic indices up to the overall index.

One of the main tasks in dealing with price indices in practice consists in updating the weights. In a broad sense, depending on the frequency of updating, PPIs are distinguished between fixed base indices and chained indices. Fixed base indices are commonly updated every five years while chained indices are typically updated once a year. At the time of writing, most statistical offices use fixed base indices but the attention drawn towards chaining techniques is increasing. It is worth noting that from a strictly technical point of view, chained indices can be approached by updating the samples (products and reporting units) and by updating the weights structure.

Some topics concerning the practice of chaining PPIs are presented in more detail because, even if most countries still calculate a fixed base index, the interest in chain-linking the PPI seems to be increasing.

Notation

In the examples products and reporting units are denoted by numbers: 1, 2, …

Representative products (in other words the products manufactured by the reporting units for which price quotes are provided) ([4]) and aggregates are denoted, respectively, by lower and upper case letters (a, b, c, …; A, B, C, …). The highest aggregate or the overall index is denoted by Z.

Prices, price relatives and indices are denoted by p, P and I.

Absolute and relative weights are denoted by W and w.

Indices rates of change and contributions (or index rate of change decomposition) are denoted by D and C.

The time variable is shown as Y and when it is necessary, Y is replaced by the couple (y, m) denoting year, and month respectively.

The following formula

[9.1]
$$I_T^{(y,m)} = \sum_{A \in T} I_A^{(y,m)} \times w_A$$

where

([4]) The term product has several meanings: it refers to a heading or an aggregate identified by a code and a description (in a classification); it is also an element for which a price is observed (the representative product manufactured by the enterprise).

$$w_A = \frac{W_{A \in T}}{\sum_A W_A} \Rightarrow \sum_A w_A = 1$$

shows that the index (T) at time (y, m) is equal to a weighted mean of sub-indices A, each one multiplied by its own relative weight. In the formula [9.1] the symbol w indicates the weights relatives whose sum, by construction, is equal to 1.

Background

The coverage and classification of PPIs are defined in terms of NACE Rev. 2. The analysis (breakdown) includes classes (4-digit level), groups (3-digit level), divisions (2-digit level), sections (1-letter level) and the overall index (for industry). Furthermore, indices are also allocated in terms of main industrial groupings (MIGs) which are obtained by aggregating NACE groups. In practice, below the NACE class level, indices are compiled using product classifications/lists such as the Prodcom list, CN or CPA.

In principle indices can be formed by aggregation either by activity or by product. However, as the product classifications/lists are linked to the activity classification, each elementary price index can be regarded as being assigned both to product and activity classifications. Such a characteristic makes it possible to compile the overall index whether aggregating by activity or by product and the weights are said to be nested because each elementary price index has its own weight in the product and activity classification. As the weights structure is nested each aggregation level gives the total sum of weights, in other words they sum to 1 (or a multiple thereof).

Producer price indices are constructed from elements. The identification of the elements derives from the appropriate classification. When the Prodcom list or the CN is used the element is a product identified by an 8-digit code and its description. When the CPA is used the element is a product identified by a 6-digit code and its description.

Each reporting unit provides a set of price quotations referring to selected representative products.

Methods

Calculating price relatives

Once collected, price quotations (or simply prices) are first converted to ratios or price relatives, by dividing each current price by a common denominator or index base. Therefore, a price relative is defined as the ratio between the current month's price and the base price. For product a, the equation [9.2] is the price relative associated with the product a observed at time (y, m).

[9.2]
$$P_a^{y,m} = \frac{p_a^{y,m}}{\bar{p}_a^0} \times 100$$

The current price is the numerator of the ratio. The base price is the denominator of the ratio and actually shows the index base at the time Y = 0. Commonly, such a denominator is defined as a mean of the 12 monthly prices of the base year (fixed base index), or it is equal to the base monthly price used for the annual chain linking (chained index or index with annual link on a monthly base). In this last case, the price relative formula is given in [9.3].

[9.3]
$$P_a^{y,m} = \frac{p_a^{y,m}}{p_a^{y-1,12}} \times 100$$

Worked example: calculation of price relative

The table below shows a set of monthly prices for four years for the representative product a.

Monthly prices per year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
y=0	13.1	13.3	13.3	13.5	13.5	13.7	14.0	14.0	14.0	14.2	14.2	14.5	13.8
y=1	14.8	15.0	15.0	14.5	14.4	14.0	14.1	13.9	13.5	14.4	15.0	16.0	14.6
y=2	16.3	16.3	16.5	16.5	16.5	16.8	17.0	17.0	17.0	17.2	17.2	17.5	16.8
y=3	17.1	17.4	18.0	17.2	17.5	17.5	18.2	18.3	18.1	18.6	18.5	17.9	17.9

The last column of the above table is the annual mean. In a fixed base context, price relatives are compiled by applying the equation [9.2] where the denominator is equal to the annual mean of the year y = 0, as shown in the table below.

Monthly price relatives – fixed base

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
y=0	95.1	96.6	96.6	98.0	98.0	99.5	101.6	101.6	101.6	103.1	103.1	105.3
y=1	107.4	108.9	108.9	105.3	104.5	101.6	102.4	100.9	98.0	104.5	108.9	116.2
y=2	118.3	118.3	119.8	119.8	119.8	122.0	123.4	123.4	123.4	124.9	124.9	127.0
y=3	124.1	126.3	130.7	124.9	127.0	127.0	132.1	132.8	131.4	135.0	134.3	129.9

For instance, in May (m=5) of y=2 the formula [9.2] is:

$$P_a^{(2,5)} = \frac{16.5}{13.8} \times 100 = 119.8$$

When indices are annually linked on a monthly base, price relatives are compiled by applying the equation [9.3], as shown in the table below.

Monthly price relatives – chained

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
y=0	90.3	91.7	91.7	93.1	93.1	94.5	96.6	96.6	96.6	97.9	97.9	100.0
y=1	102.1	103.4	103.4	100.0	99.3	96.6	97.2	95.9	93.1	99.3	103.4	110.3
y=2	101.9	101.9	103.1	103.1	103.1	105.0	106.3	106.3	106.3	107.5	107.5	109.4
y=3	97.7	99.4	102.9	98.3	100.0	100.0	104.0	104.6	103.4	106.3	105.7	102.3

For instance, in May (m=5) of y=2 the result is the following:

$$P_a^{2,5} = \frac{16.5}{16.0} \times 100 = 103.1$$

Elementary price index calculation

The elementary price index can be compiled in several ways, depending on how the information on reporting units and representative products is actually managed. Mainly, two methods can be distinguished: the weighted and the unweighted mean of price relatives. In price index literature, the unweighted arithmetic and geometric mean are respectively known as Carli and Jevons indices. The formulas below concern these two indices for the fixed base (shown in formulas [9.4] and [9.5]), and the chained index (shown in formulas [9.6] and [9.7]) where the subscript A points out the elementary product index, while the sum runs on i = (1, …, n) price relatives P.

[9.4] $$I_A^{(y,m)} = \frac{1}{n} \sum_{i=1}^{n} P_{i,A}^{(y,m)} = \frac{1}{n} \sum_{i=1}^{n} \frac{p_{i,A}^{(y,m)}}{\bar{p}_{i,A}^{0}}$$

where

$$\bar{p}_i^0 = \frac{1}{12}\sum_{i=1}^{12} p_{i,A}^{(0,m)}$$

[9.5] $$I_A^{(y,m)} = \prod_{i=1}^{n}\left(P_{i,A}^{(y,m)}\right)^{1/n} = \prod_{i=1}^{n}\left(\frac{p_i^{(y,m)}}{p_{i,A}^0}\right)^{1/n} = \frac{\prod_{i=1}^{n}\left(p_{i,A}^{(y,m)}\right)^{1/n}}{\prod_{i=1}^{n}\left(p_{i,A}^0\right)^{1/n}}$$

[9.6] $$I_A^{(y,m)} = \frac{1}{n}\sum_{i=1}^{n} P_{i,A}^{(y,m)} = \frac{1}{n}\sum_{i=1}^{n}\frac{p_{i,A}^{(y,m)}}{p_{i,A}^{(y-1,12)}}$$

[9.7] $$I_A^{(y,m)} = \prod_{i=1}^{n}\left(P_{i,A}^{(y,m)t}\right)^{1/n} = \prod_{i=1}^{n}\left(\frac{p_{i,A}^{(y,m)}}{p_{i,A}^{(y-1,12)}}\right)^{1/n} = \frac{\prod_{i=1}^{n}\left(p_{i,A}^{(y,m)}\right)^{1/n}}{\prod_{i=1}^{n}\left(p_{i,A}^{(y-1,m)}\right)^{1/n}}$$

A comparison of the formulas presents two approaches: the unweighted (stochastic) approach and the weighted (economic) approach. Each of these approaches has its own internal coherency and founder: Edgeworth for the stochastic approach and Keynes for the economic approach. From a practical point of view, preference in the statistical offices seems to be that, if low-level weighting data are not available, the choice is the Jevons index (using the geometric mean); otherwise, there is a preference for the weighted arithmetic mean (a summary of methods is presented later).

Worked example: calculation of elementary price index

By assuming that the reporting units 1, 2 and 3 manufacture the items (a, b, c), (d, e) and (f, g) respectively, the available price relatives are the following (based on data in the subsequent table).

$$P_{a,1} = \frac{61}{55}\times 100 = 110.9$$

...

$$P_{g,3} = \frac{29}{21}\times 100 = 138.1$$

Compiling price relatives I

Product	Reporting unit	Representative products	Prices at time T= t	Prices at time T=t+1	Price relatives at time T=t+1
[1]	[2]	[3]	[4]	[5]	[6]
K	1	a	55	61	110.9
K	1	b	38	36	94.7
K	1	c	186	194	104.3
K	2	d	29	37	127.6
K	2	e	37	32	86.5
K	3	f	165	171	103.6
K	3	g	21	29	138.1

The weighted mean of the price relatives can be carried out at the level of the reporting units, in other words by weighting each reporting unit with its own production value; equally it can be carried out by using the weight of each representative product. The weights systems are shown in the following table.

- Each reporting unit has its own weight as provided by an appropriate source (for example an annual survey of industrial production). These weights are shown in column 3 of the table below – these weights sum to 100 % (when counting each reporting unit once).
- The weights systems within the reporting units are independent (in other words each reporting unit has its own weighting system for its representative products). These weights are shown in column 5 of the table below – these weights also sum to 100 % within each reporting unit, and sum to 300 % because there are three reporting units in the example.
- When integrating the weights of the reporting units with the weights associated with the representative products a set of weights can be produced for each individual representative product within the elementary aggregate K. These weights are shown in column 6 of the table below – these weights also sum to 100 % within the elementary aggregate K.

It should be noted that in practice the information for the weights of the individual representative products is rarely available.

Compiling price relatives II

Product	Reporting unit	Reporting units' weight	Representative products	Representative products' weights within reporting unit	Representative products' weights within the product K
[1]	[2]	[3]	[4]	[5]	[6]
K	1	45	a	60	27.0
K	1	45	b	30	13.5
K	1	45	c	10	4.5
K	2	35	d	55	19.2
K	2	35	e	45	15.8
K	3	20	f	80	16.0
K	3	20	g	20	4.0

Using the price relatives and the weights shown in the two previous tables, the elementary price index (for product K) can be compiled in different ways – these are shown in the following table. The aim of this example is to show that when the elementary price index is calculated as a weighted mean of price quotations, the same results are achieved when weighting based on the reporting unit's production value or based on the value for the individual representative products. In other words, the results are the same because the weights systems used within the reporting units (column 5 above) can be integrated with the weights of the individual reporting units (column 3 above).

Compiling the elementary price index

Product	[1]	K
Price relatives aggregation by unweighted geometric mean	[2]	108.1
Price relatives aggregation by unweighted arithmetic mean	[3]	109.4
I - Price relatives aggregation by weighted arithmetic mean per reporting unit	[4]	107.1
II - Price relatives aggregation by weighted arithmetic mean per reporting unit	[5]	108.2
Price relatives aggregation by direct weighted arithmetic mean	[6]	107.7
Price relatives aggregation by indirect arithmetic mean	[7]	107.7

In the rows [2] and [3] of the table above the elementary price index is compiled using simple (unweighted) geometric and arithmetic means respectively.

$$I_K = (110.9 \times 94.7 \times 104.3 \times ... \times 138.1)^{1/7} = 108.1$$

$$I_K = \frac{1}{7} \times (110.9 + 94.7 + 104.3 + ... + 138.1) = 109.4$$

If the weights of the representative products are not known, another way to derive the elementary price index is to compile a weighted arithmetic mean of price relatives using just the weights of the reporting units as shown in rows [4] and [5] above. Again, this can be done synthesising the price relatives using a geometric mean or an arithmetic mean (as shown below) using weights of the reporting units only.

$$I_K = [(103.1 \times 0.45) + (105.1 \times 0.35) + (119.6 \times 0.20)] = 107.1$$

where

$$103.1 = (110.9 \times 94.7 \times 104.3)^{1/3}$$

$$105.1 = (127.6 \times 86.5)^{1/2}$$

$$119.6 = (103.6 \times 138.1)^{1/2}$$

$$I_K = [(103.3 \times 0.45) + (107.1 \times 0.35) + (120.9 \times 0.20)] = 108.2$$

where

$$103.3 = \frac{1}{3}(110.9 + 94.7 + 104.3)$$

$$107.1 = \frac{1}{2}(127.6 + 86.5)$$

$$120.9 = \frac{1}{2}(103.6 + 138.1)$$

If a full set of weights are available, namely weights for reporting units and weights for representative products within the reporting units, the elementary price index can be calculated as a weighted arithmetic mean of price relatives. This can be done using a direct or an indirect method – the results are the same and are shown in rows [6] and [7] of the table above. The direct method is a weighted mean of indices for the reporting units where the index for each reporting unit is calculated as a weighted mean of each representative product within the corresponding reporting unit.

$$I_K = [(110.9 \times 0.6) + (94.7 \times 0.3) + (104.3 \times 0.1)] \times 0.45$$
$$+ [(127.6 \times 0.55) + (86.5 \times 0.45)] \times 0.35$$
$$+ [(103.6 \times 0.8) + (138.1 \times 0.2)] \times 0.20 = 107.7$$

The same result can be achieved using the weights of each representative product with its relative.

$$I_K = [(110.9 \times 0.27) + (94.7 \times 0.135) + (104.3 \times 0.045)]$$
$$+ [(127.6 \times 0.192) + (86.5 \times 0.158)]$$
$$+ [(103.6 \times 0.16) + (138.1 \times 0.04)] = 107.7$$

The chained elementary price index

For chained indices, an elementary aggregate may change in composition without disturbing the index. This situation also occurs also when a comparison is made between two sets of adjacent fixed base indices, but when indices are chained annually this occurs more frequently. In particular, this issue can be relevant when calculating the twelve-month index rate of change.

As an example, aggregate A is made up of three products (1, 2 and 3) at times Y=t and Y=t+1. The table below illustrates how i) their weights change; ii) and how the availability of representative products change, in other words the items b, e and h cease to be available between Y=t and Y=t+1 while the new items d, h, i, j and m are introduced by time Y=t+1.

Elementary price index composition

		Y = t						Y = Y + 1				
		Product	Repre-sentative product	Weight	...	Jun	Dec	Product	Repre-sentative product	Weight	...	Jun
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
1	**Prices**											
1.01		1	a	-	...	16.8	17.5	1	a	-	...	17.5
1.02		1	b	-	...	56.0	59.0	1	-	-	...	-
1.03		1	c	-	...	15.0	16.0	1	c	-	...	16.8
1.04		1	-	-	...	-	-	1	d	-	...	22.8
1.05		2	e	-	...	3.8	4.5	2	-	-	...	-
1.06		2	f	-	...	14.0	15.0	2	f	-	...	15.5
1.07		2	g	-	...	7.0	7.7	2	g	-	...	7.9
1.08		2	-	-	...	-	-	2	h	-	...	29.9
1.09		2	-	-	...	-	-	2	i	-	...	139.8
1.10		2	-	-	...	-	-	2	j	-	...	1091.6
1.11		3	k	-	...	14.0	15.0	3	-	-	...	-
1.12		3	l	-	...	5.0	6.0	3	l	-	...	6.5
1.13		3	-	-	...	-	-	3	m	-	...	47.1
2	**Price relatives (December Y-1 =100)**											
2.01		1	a	-	...	105.0	109.4	1	a	-	...	100.0
2.02		1	b	-	...	103.7	109.3	1	-	-	...	-
2.03		1	c	-	...	111.1	118.5	1	c	-	...	105.0
2.04		1	-	-	...	-	-	1	d	-	...	107.5
2.05		2	e	-	...	115.2	136.4	2	-	-	...	-
2.06		2	f	-	...	107.7	115.4	2	f	-	...	103.3
2.07		2	g	-	...	116.7	128.3	2	g	-	...	102.6
2.08		2	-	-	...	-	-	2	h	-	...	93.4
2.09		2	-	-	...	-	-	2	i	-	...	113.8
2.10		2	-	-	...	-	-	2	j	-	...	101.1
2.11		3	k	-	...	107.7	115.4	3	-	-	...	-
2.12		3	l	-	...	108.7	130.4	3	l	-	...	108.3
2.13		3	-	-	...	-	-	3	m	-	...	100.6
3	**Elementary price index – calculation base**											
3.1		1		0.6	...	106.6	112.3	1		0.3	...	104.1
3.2		2		0.1	...	113.1	126.4	2		0.6	...	102.6
3.3		3		0.3	...	108.2	122.7	3		0.1	...	104.4
4	**Elementary price index – reference base**											
4.1		1		-	...	154.0	162.3	1		-	...	169.0
4.2		2		-	...	183.4	205.0	2		-	...	166.6
4.3		3		-	...	142.2	161.3	3		-	...	169.5
5	**Laspeyres indices – calculation base**											
5.1		A		1.0	...	107.7	116.8	A		1.0	...	103.3
6	**Laspeyres indices – reference base**											
6.1		A			...	168.0	182.2	A			...	188.1

The formula below shows the index rate of change of A between June (Y) and June (Y+1).

$$D_A = \frac{188.1 - 168.0}{168.0} \times 100 \cong 12$$

In fact this variation embodies the different weights composition within A of the products (1, 2 and 3) at time Y=t (0.6, 0.1 and 0.3) and at Y=t+1 (0.3, 0.6 and 0.1). Furthermore, the level of the index is determined by different sets of representative products: at time Y=t, there are eight price relatives (each referring to one representative product) that contribute to calculate the three products, while at time Y=t+1 the number of price relatives has grown to ten. As such the sets of price relatives at Y=t and Y=Y+1 are different (as noted above because of representative products leaving and entering the market) and so are not exactly comparable.

Higher-level indices

Generally the Laspeyres type index is used by statistical offices for higher-level indices. This uses a weighted arithmetic mean. Weights refer to the structure at the beginning of the time series, but in practice these are updated periodically and the time series using different weights chained. The following table presents an index composed of four elementary aggregates (A1 to B2) two higher aggregates (A and B) as well as an overall index.

Nested Laspeyres indices

Representative product	Base price	Current price	Price relative	Elementary aggregate	Elementary aggregate weight	Elementary price index	Higher level aggregate	Higher level weight	Laspeyres aggregate indices	Laspeyres overall index
1	1.81	1.75	96.8							
2	2.20	2.08	94.8							
3	276.16	320.00	115.9							
4	368.52	394.90	107.2							
5	224.89	225.00	100.1							
6	3.46	3.85	111.1							
7	2.04	2.30	112.7							
8	2.13	2.40	112.8							
				A1	**695.0**	**106.1**				
1	6.78	5.40	79.7							
2	3.21	3.34	104.0							
3	2.56	2.35	91.8							
4	2.21	2.72	123.1							
5	2.14	2.58	120.5							
6	3.21	3.51	109.2							
7	2.34	2.13	90.9							
8	3.54	3.77	106.7							
9	2.54	2.97	116.9							
10	1.25	1.51	120.8							
11	2.44	2.34	95.9							
12	3.37	3.74	111.1							
				A2	**3672.0**	**105.0**				
							A	**4367**	**105.2**	
1	0.72	1.05	146.1							
2	1.22	1.58	129.2							
3	1.90	2.46	129.5							
4	1.08	1.44	133.9							
5	1.76	1.79	101.8							
6	1.55	1.78	114.8							
7	1.33	1.94	146.0							
8	1.52	1.55	101.8							
9	1.62	1.65	101.8							
				B1	**689.0**	**121.5**				
1	1.54	1.70	110.5							
2	1.50	1.65	110.3							
3	2.09	2.40	114.9							
4	1.87	2.18	116.3							
5	1.93	2.20	114.1							
6	1.59	2.20	138.1							
7	1.60	1.79	111.8							
				B2	**63.0**	**115.7**				
							B	**752**	**121.0**	
										107.5

The weights are nested because their sum at the elementary level (Products A1 to B2, shown in the formula below using k for the elementary aggregates) is equal to their sum at the aggregate level (A and B).

$$\sum_{k=1}^{4} W_k = 695 + 3672 + 689 + 63 = 5119$$

and

$$\sum_{A,\,B} W_{A,\,B} = 4367 + 752 = 5119$$

In terms of weights relatives

$$\sum_{k=1}^{4} w_k = \frac{695}{5119} + \frac{3672}{5119} + \frac{689}{5119} + \frac{63}{5119} = 1$$

and

$$\sum_{A,\,B} w_{A,\,B} = \frac{4367}{5119} + \frac{752}{5119} = 1$$

Fixed base and chain indices

Depending on the frequency of updating weights, fixed base and chained indices may be distinguished. It is worth noting that various updating procedures can be considered. This emerges in particular when dealing with indices updated once a year. Strictly speaking, when re-weighting involves drawing a new sample of products and a new list of reporting units a chained index is the result. This kind of index is characterised by an annual update of products (at the elementary aggregate level), reporting units and the representative products. A less ambitious alternative is to limit the annual update to the weights, without introducing/removing new/old products (at the elementary aggregate level), reporting units and representative products. In this way the indices are always annually chained; for purposes of presentation the reference base (set to = 100) needs to be updated as though it were a fixed base.

As said at the beginning of this chapter, the aggregation structure for a PPI is often established by combining activity and product classifications/lists – for example NACE or ISIC for activities and Prodcom or CPA for products. In this way, the entire set of products covered by the PPI can be divided between higher and lower level indices. Among the first group can be identified the activity aggregates, normally from the 4-digit level of NACE (classes) up to the overall index. These indices are calculated by the Laspeyres formula. Indices for the intermediate levels (between the 4-digit level and the elementary aggregate level which is often around the 8-digit level) might not be calculated. The final result is that the overall output price index (in other words the highest level of aggregation) is a weighted average of activity and product price indices calculated on the basis of a nested classification.

Updating samples within chain linking

The basic elements of the PPI survey are products (at the elementary aggregate level), reporting units and representative products. Theoretically the selection of products and representative products should be unchanged while the index base lasts, as reporting units can be substituted.

In a broad sense, a price index is based on the idea of measuring the price dynamics of a selection of items. Such dynamics can be observed by referring to a fixed basket of items over a certain period of time. In this way it is in principle possible to measure the pure price index dynamic because the items are kept as fixed as possible so that price variations are not affected by flows (changes) in the items.

As regards the representative products, quality changes occur when products are no longer available on the market or their price-determining characteristics change.

In practice reporting units change, for example through the creation of new units, or mergers. Such changes require appropriate measures to ensure the sample remains representative.

Usually, the base of an index number lasts five years (fixed base index) or one year (annually chained index). What is worth noting is that the re-basing procedure, carried out every five years or once a year, involves simultaneously updating the selection and weights of products (at the elementary aggregate level), the list of reporting units and the set of representative products. The practices in the statistical offices show that there are intermediate situations between a fixed base and a chained index. This is the reason why if the index base is fixed every five years, the survey practice can also involve an annual updating of the product weights.

Chain-linking

In general, an index is said to be annually chained if its weights system is annually updated. Technically, chain-linking of the PPI is annually carried out on a monthly base. Commonly, December of the previous year is the month chosen as the link of the chain. In December of the year Y-1 the new calculation base for the year Y is set up. Such a work implies the updating of the selection of products (at the elementary aggregate level), the list of reporting units and the set of representative products. The update of the list of reporting units is a practical matter for data collection but does not have a direct effect in compiling indices.

The set of products and representative products priced in December Y-1 comprises two sub-sets: the old set inherited from the previous (in fact current year Y-1) calculation base; the new set that will contribute to the index calculation base in the future (year Y). Generally the two subsets do not have to be disjoint (mutually exclusive), as in practice only part of the sample is renewed annually and so there is an overlap. Once updated (and data has been collected) the new series of price relatives will be calculated. This means that, starting from January in year Y, the denominator of the ratios will be given by the price quotation at time December of year Y-1 (such a denominator, for the items entered in the new calculation base is equal to 100).

The new basket of products has a new weights system. Weights are always provided for elementary aggregates and where possible also for more detailed levels within elementary aggregates. The aggregation of elementary price indices is the first step in the index calculation procedure where weights are mandatory for all product categories ([5]).

At the beginning of this chapter a general notation was introduced, and for the chain index formulas it is necessary to add just the symbol B, for identifying the reference base, and to introduce a subscript for distinguishing calculation and reference base indices.

First of all, the above formula [9.1] is still valid but needs to be partially updated in its original notation. Therefore, given the aggregate A, its calculation and reference base formulas will be respectively:

[9.8] $$I^{(y,m)}_{y-1,12;\,A} = \sum_{a \in A} I^{(y,m)}_{y-1,12;\,a} \times w_{y-1,12;\;a}$$

[9.9] $$I^{(y,m)}_{B;\,A} = I^{(y,m)}_{y-1,12;\,A} \times \prod_{j=B}^{y-1} \left(I^{(j,12)}_{j-1,12;\,A} \div 100 \right)$$

The subscript (y-1,12) shows the calculation base, in other words the month of December of the previous year (in the example discussed above). The formula [9.9] shows that the index with a particular reference base (B) can be compiled from an index with the calculation base (y-1,12) by multiplying that index with previously chained (calculation base) indices, each of them referring to its own calculation base. The formula [9.9] has its equivalent in the following

[9.10] $$I^{(y,m)}_{B;\,A} = I^{(y,m)}_{y-1,12;\,A} \times \left(I^{(y-1,12)}_{B;\,A} \div 100 \right)$$

Worked example of chaining

The starting position is a set of monthly indices in their calculation base (y-1,12) for a certain period of time, starting at time B=0. These are shown in the following table.

([5]) Indeed, although is not a common practice used by the statistical offices, price relatives can also be defined by using an appropriate weights system.

Important note: Y=0 is the first year in this time series, and so the index for the months during the year Y=0 are expressed not in relation to December of the previous year (-1,12) for which no value is available, but in relation to the average for the year Y=0.

Calculation of base indices

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Y = 0	…	…	…	…	98.9	…	…	…	…	…	…	100.2
Y = 1	…	…	…	…	100.8	…	…	…	…	…	…	101.5
Y = 2	…	…	…	…	100.6	…	…	…	…	…	…	101.9
Y = 3	…	…	…	…	100.2	…	…	…	…	…	…	101.0
Y = 4	100.1	99.8	99.9	100.3	100.4	100.7	100.5	100.3	99.9	100.1	100.5	100.7

The corresponding set of indices in the reference base B can be calculated by applying the formula [9.9]. For instance, at the time (Y=4, m=5), the reference base index – for the aggregate A – is:

$$I^{(4,5)}_{0;A} = I^{(4,5)}_{3,12;A} \times \prod_{j=0}^{3}\left(I^{(j,12)}_{j-1,12;A} \div 100\right) =$$

$$= I^{(4,5)}_{3,12;A} \times \frac{I^{(3,12)}_{2,12;A}}{100} \times \frac{I^{(2,12)}_{1,12;A}}{100} \times \frac{I^{(1,12)}_{0,12;A}}{100} \times \frac{I^{(0,12)}_{0;A}}{100}$$

$$= 100.4 \times (1.010 \times 1.019 \times 1.015 \times 1.002) \approx 105.1$$

Using the equivalent formula [9.10] gives

$$I^{(4,5)}_{0;A} = I^{(4,5)}_{3,12;A} \times \left(I^{(3,12)}_{0;A} \div 100\right) = 100.4 \times \frac{104.7}{100} \approx 105.1$$

By applying the same formula the results in the following table are produced.

Reference base indices Y = 0

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Y = 0	…	…	…	…	98.9	…	…	…	…	…	…	100.2
Y = 1	…	…	…	…	101.0	…	…	…	…	…	…	101.7
Y = 2	…	…	…	…	102.3	…	…	…	…	…	…	103.6
Y = 3	…	…	…	…	103.8	…	…	…	…	…	…	104.7
Y = 4	104.8	104.5	104.6	105.0	105.1	105.4	105.2	105.0	104.6	104.8	105.2	105.4

Worked example of rescaling

The data in the above example can be reused to present another topic related to chaining which is the rescaling of the reference base. The reference base is a way of presenting as a time series several indices that would otherwise not be comparable, for example when the calculation base is updated annually. Changing the reference base simply consists in a rescaling practice and can be done at any time.

If it is decided to change the reference base so that B = Y = 4. Starting from indices with B = Y = 0, the rescaling coefficient is simply the arithmetic mean of the 12 monthly indices in the year of the new reference base. Therefore the rescaling coefficient is:

$$\bar{I}^{4}_{B=0} = \frac{1}{12}\sum_{m=1}^{12} I^{4,m}_{B=0} \div 100 \approx 1.05$$

The monthly indices within the new reference base are found as follows

$$I^{4,1}_{B=4} = \frac{I^{4,1}_{B=0}}{\bar{I}^{4}_{B=0}} = \frac{104.8}{1.05} = 99.8$$

…

$$I^{4,12}_{B=4} = \frac{I^{4,12}_{B=0}}{\bar{I}^{4}_{B=0}} = \frac{105.4}{1.05} = 100.4$$

The same time series as presented before (with B = Y = 0) can now be presented with the new reference base (B = Y = 4) and this is shown in the following table.

Reference base indices Y = 4

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Y = 0	…	…	…	…	94.2	…	…	…	…	…	…	95.4
Y = 1	…	…	…	…	96.2	…	…	…	…	…	…	96.9
Y = 2	…	…	…	…	97.4	…	…	…	…	…	…	98.7
Y = 3	…	…	…	…	98.9	…	…	…	…	…	…	99.6
Y = 4	99.8	99.5	99.6	100.0	100.1	100.4	100.2	100.0	99.6	99.8	100.2	100.4

It holds that, during the year Y = 4, the simple arithmetic mean of the monthly indices is equal to 100, as it was in the year Y = 0 for the previous reference base, so that

$$\frac{1}{12}\sum_{m=1}^{12} I^{4,m}_{B=4} = 100 = \frac{1}{12}\sum_{m=1}^{12} I^{0,m}_{B=0}$$

Finally, it should be noted that the rescaling does not affect either the month-to-month index rate of change or the 12-month index rate of change. The results shown below confirm that the rescaling does not produce any effect on the month-to-month and the 12-month indices rate of change paths, other than issues related to rounding (which can be avoided by rescaling indices presented with more decimal places).

Reference base index comparison after re-scaling

Month	Month-to-month index rate of change		Month/Year	Twelve-month index rate of change	
	Reference base Y = 0	Reference base Y = 4		Reference base Y = 0	Reference base Y = 4
Jan	0.2	0.2	May Y = 1	2.1	2.1
Feb	-0.3	-0.3	May Y = 2	1.2	1.3
Mar	0.1	0.1	May Y = 3	1.5	1.5
Apr	0.4	0.4	May Y = 4	1.2	1.3
May	0.1	0.1			
Jun	0.3	0.3	Dec Y = 1	1.6	1.5
Jul	-0.2	-0.2	Dec Y = 1	1.9	1.9
Aug	-0.2	-0.2	Dec Y = 1	0.9	1
Sep	-0.4	-0.4	Dec Y = 1	0.8	0.8
Oct	0.2	0.2			
Nov	0.4	0.4			
Dec	0.2	0.2			

The chained index rate of change decomposition

As already explained, PPI are constructed using a nested classification. Therefore the overall index is always the result of the aggregation of components. Chain-linking firstly implies that indices are compiled in terms of their calculation base; then, to allow the time series comparison, indices are re-calculated and disseminated in terms of a reference base. However, the latter base is not additive. A major problem in dealing with chained indices is the interpretation of the decomposition of their rate of change, in other words, how to measure the contribution of each lower level aggregate k in determining the overall index rate of change.

The method suggested by Ribe ([6]) provides an interesting way to approach this subject. In the Annex, following the work of Ribe, the decomposition of the 12-month rate of change is examined and an example provided.

In summary, such a decomposition consists of measuring the additive contribution of each component to the overall index rate of change. Using the 12-month rate of change, its formula for the overall index is

[9.12]
$$D_B^{y,y-1} = \frac{I_B^{y,m}}{I_B^{y-1,m}} - 1$$

while for any k component (or lower level aggregate), it can be written as

[9.13]
$$D_{B;k}^{y,y-1} = \frac{I_{B;k}^{y,m}}{I_{B;k}^{y-1,m}} - 1$$

The core of the method is that by summing over k (in other words all the components) equations [9.13], the result is not equal to [9.12]:

[9.14]
$$\sum_k D_{B;k}^{y,y-1} \neq D_B^{y,y-1}$$

However, a suitable representation in terms of indices compiled in the calculation base provides the additive decomposition of the overall index rate of change. In other words, the summation over k of the components contributions is equal to the overall index 12-month rate of change. In formulas, this means that

[9.15]
$$\sum_k C_{y-1,m;k}^{y,m} = D_B^{y,y-1}$$

Methods applied in practice

Calculation of elementary price indices

A survey of the 17 countries participating in the PPI task force indicated that the most widely used methods for aggregating price relatives are the unweighted geometric mean and the weighted arithmetic mean; a simple arithmetic mean was also used in some countries while none of the countries use a weighted geometric average.

([6]) Ribe, M., Effects of subcomponents on chained price indices like the HICP and the MUICP, 1999.

Elementary price index formula

	Simple arithmetic mean	Simple geometric mean	Weighted arithmetic mean
BG	x		
CZ			x
DK		x	
DE			x
ES	x		
FR			x
IT		x	
LT			x
HU	x		
NL			x
AT		x	
PL			x
SI			x
FI		x	
SE			x
UK		x	
TR			x

Source: PPI task force

Calculation of higher level indices

The Laspeyres type index is the most widely used formula for calculating the PPI; in fact a survey of participants in the PPI task force showed that the higher level indices are always calculated by the Laspeyres type index formula with the exception of Poland where a Paasche type index is compiled. Differences in the PPI calculation procedures depend on i) the lower index digit-level and its weights source; ii) the higher indices digit-level and their weight source; iii) the frequency of the weights updating procedure; iv) and the kind of index, fixed base or chained.

Concerning the product indices, the most widely used source for weights is the Prodcom survey although national accounts data are also used; some countries also have weights presented using the CPA (source unknown). The table below shows that the lower level indices are often calculated using a national version of the Prodcom list, for example at a 9 or 10-digit level. The variable provided by the Prodcom survey is the value of the production sold (for the domestic PPI it should be limited to sales on the domestic market).

Lowest level of index detail (PPI on the domestic market)

	Lowest index level (digits)	Source of weights
BG	8	Prodcom
CZ	6	CPA
DK	6	National accounts
DE	9	Prodcom
ES	8	Prodcom
FR	4	National accounts (CPA)
IT	8	Prodcom
LT	10	Prodcom
HU	8	Prodcom
NL	6	Prodcom
AT	10	Prodcom
PL	7	CPA
SI	8	Prodcom
FI	6	National accounts
SE	8	Prodcom
UK	6	CPA
TR	10	Prodcom

Source: PPI task force

The most common practice for defining higher level indices is to provide activity based aggregates at the 4-digit level and higher. From this level upwards the weights normally concern the value of turnover from structural business statistics (SBS) or from national accounts, and in some cases Prodcom data is also used at these higher levels.

Higher level indices and source of weights (PPI on the domestic market)

	DL	WS
BG	3	SBS
CZ	4	SBS
DK	4	National accounts
DE	4	SBS
ES	4	SBS
FR	4	National accounts (CPA)
IT	4	National accounts
LT	4	Prodcom
HU	4	Prodcom
NL	4	National accounts
AT	4	National accounts
PL	4	SBS
SI	4	SBS
FI	4	National accounts
SE	4	Prodcom
UK	4	Prodcom
TR	4	National accounts

Source: PPI task force

Updating frequency

The table below shows the frequency of updating samples and weights. When dealing with the frequency of updating the selection of reporting units this concerns a major exercise to select a new sample; there may be an additional, continuous maintenance of the list of reporting units (for example to take account of units merging or dying). Two types of indices are used, namely fixed base and chained – concerning country practices neither dominates. As can be seen there is a direct relation between the frequency of updating the weights and the use of chaining. In a similar manner there is a close relation between the frequency of updating the selection of reporting units and the weights/chaining.

Frequency of updating selections and weights (in years); use of chaining or fixed base indices

	Frequency of updating selection:				
	Products	Reporting units	Weights	Fixed base	Chained
BG	5	5	5	x	
CZ	1	1	5	x	
DK	5	5	5	x	
DE	5	5	5	x	
ES	5	5	5	x	
FR	5	5	5	x	
IT	1	1	1		x
LT	1	1	1		x
HU	1	1	1		x
NL	5	5	5	x	
AT	1	1	1		x
PL	1	1	5		x
SI	1	1	1		x
FI	5	5	5	x	
SE	1	1	1		x
UK	1	5	5	x	
TR	1	1	1		x

Source: PPI task force

Conclusions

There are different methods for updating the elements (products/weights, reporting units and representative products) of a PPI. Even in a fixed base index, reporting units are currently substituted and the set of representative products is continuously maintained. Furthermore, weights may also be updated with a higher frequency compared with that of the rebasing operations.

Chain-linking requires more work to update the basket of products and its weights system, as well as the set of representative products. In some ways it can be considered that the quality of chained indices is higher than fixed base indices because samples are more representative as they are more frequently updated. On the other hand, chain-linking is more expensive.

At present, most statistical offices still compile the PPI as fixed base indices. The situation is not static as some countries already produce chain indices while others are preparing the introduction of these practices: the trend suggests that chaining techniques are at least a good practice for compiling the PPI.

Annex – Chaining and the additive decomposition of overall index rates of change

Presentation of the deconstruction

Assuming that the overall index is given by the aggregation of k components, its calculation base formula is

[A.1]
$$I_{y,0}^{(y,m)} = \sum_k I_{y,0;k}^{(y,m)} \times w_{y,0;k}$$

In [A.1] $w_{y,0;k}$ is the weight of the component k, so that $\sum_k w_{y,0;k} = 1$; the superscript (y, m) indicates the current time (year, month), while the subscript (y, 0) shows the calculation base: (y, 0) stands for the month 0 in the year y.

As seen, the 12-month rate of change of the overall index and for any of its components can be written respectively as

[A.2]
$$D_B^{y,y-1} = \frac{I_B^{y,m}}{I_B^{y-1,m}} - 1 \quad ;$$

[A.3]
$$D_{B;k}^{y,y-1} = \frac{I_{B;k}^{y,m}}{I_{B;k}^{y-1,m}} - 1$$

The above formulas concern the reference base. Although the corresponding formulas for the calculation base have no meaning in themselves, their definition aims to allow the decomposition of the index rate of change. Therefore, by construction, the 12-month index rate of change for the overall index and any components should be the following:

[A.4]
$$D_{y-1,m}^{y,m} = \frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}} I_{y-1,0}^{y,m} - 100$$

[A.5]
$$D_{y-1,m;k}^{y,m} = \frac{I_{y-1,0;k}^{y-1,12}}{I_{y-1,0;k}^{y-1,m}} I_{y-1,0;k}^{y,m} - 100$$

In other words, a suitable representation in terms of indices compiled in the calculation base provides the additive decomposition of the overall index rate of change. In fact, while the sum over k in formula [A.3] does not give the same value as in formula [A.2], by using the calculation base indices it is possible to get an additive decomposition of the 12-month index rate of change. This concept, in formula, can be written as

[A.6]
$$C^{y,m}_{y-1,m} = \sum_k C^{y,m}_{y-1,m;k}$$

where the additive components are shown by C. In the above formula,

[A.7]
$$C^{y,m}_{y-1,m;k} = w_{y,0;k} \times \frac{I^{y-1,12}_{y-1,0}}{I^{y-1,m}_{y-1,0}} \times \left(I^{y,m}_{y,0;k} - 1 \right)$$

$$+ \frac{w_{y-1,0;k}}{I^{y-1,m}_{y-1,0}} \times \left(I^{y-1,12}_{y-1,0;k} - I^{y-1,m}_{y-1,0;k} \right)$$

$$= C^{y,m}_{y-1,m;k}(\alpha) + C^{y,m}_{y-1,m;k}(\beta)$$

The equation [A.7] helps to separate two effects on the 12- month index rate of change, those due to the current year and those to the previous one. In formula [A.8] the first element shows the current year effect and the second one indicates the contribution to the index rate of change inherited from the past:

[A.8]
$$C^{y,m}_{y-1,m;k} = \underbrace{w_{y,0;k} \times \frac{I^{y-1,12}_{y-1,0}}{I^{y-1,m}_{y-1,0}} \times \left(I^{y,m}_{y,0;k} - 100 \right) +}_{current\ \ year\ \ effect}$$

$$\underbrace{+ \frac{w_{y-1,0;k}}{I^{y-1,m}_{y-1,0}} \times \left(I^{y-1,12}_{y-1,0;k} - I^{y-1,m}_{y-1,0;k} \right)}_{previous\ year\ \ effect}$$

$$= C^{y,m}_{y-1,m;k}(\alpha) + C^{y,m}_{y-1,m;k}(\beta)$$

Worked example

The example presents an overall index (Z) made up of four components (or lower level aggregates), labelled A to D. In the first table below are the indices and weights during (y-1).

Calculation base indices for the year y-1

	Weights	Jan	Feb	Mar	Apr	May	Jun	...	Dec
A	0.3	106.7	106.9	107.5	107.7	107.6	108.4		107.7
B	0.2	107.6	107.9	107.8	108.1	108.2	108.8		110.1
C	0.4	110.5	111.4	111.6	112.3	112.7	113.8		110.3
D	0.2	129.8	131.6	134.5	135.2	143.1	146.6		118.7
Z	1.0	112.3	113.1	113.9	114.3	115.9	117.2		111.0

Of course, for any component, the time series indices (in the calculation base) re-start once a year. So for the indices for year y – shown in the table below – the column of December (y-1) shows indices that are all equal to 100 as that is the calculation base.

Calculation base indices for the year y

	Weights	Dec y-1	Jan	Feb	Mar	Apr	May	Jun	...
A	0.3	100.0	99.9	99.8	99.9	99.7	99.6	99.4	
B	0.2	100.0	100.0	99.7	99.6	99.4	99.2	99.0	
C	0.3	100.0	98.3	97.5	96.5	96.3	96.2	96.2	
D	0.2	100.0	99.6	99.1	96.9	97.5	98.8	102.2	
Z	1.0		99.3	98.8	98.1	98.1	98.2	98.7	

In this example the year (y-1) coincides with the time 'zero' (the reference base), so that the calculation base and the reference base for the year y-1 are equal by construction. Using y-1 as the reference base, the calculation base indices for the year y (in the table above) can be transformed to be presented with y-1 as the reference base as shown in the next table. For any component k, the reference base is constructed by multiplying each calculation base index with the linking coefficient (also shown in the table below). This is given for year y by dividing the calculation base index (December y-1) by 100. For instance, for k = C and m = March, the reference base index in year y is given by

$$I^{y,3}_{B;C} = I^{y,3}_{y-1,0;C} \times \left(I^{y-1,0}_{y-1,0;C} \div 100 \right) = 96.5 \times 1.103 = 106.4$$

Reference base indices

	y								
	Weights	link	Jan	Feb	Mar	Apr	May	Jun	...
A	0.3	1.1	107.6	107.5	107.6	107.4	107.3	107.1	
B	0.2	1.1	110.1	109.8	109.7	109.4	109.2	109.0	
C	0.3	1.1	108.4	107.5	106.4	106.2	106.1	106.1	
D	0.2	1.2	118.2	117.6	115.0	115.7	117.3	121.3	
Z	1.0	1.1	110.2	109.7	108.9	108.9	109.0	109.6	

By applying the formulas [A.3] and [A.2] the 12-month index rate of change is calculated for the components A to D and for the total Z. These results are shown in the table below. For instance:

i) the result for the component k = D in June (in other words m = 6) derives from the following equation

$$D^{y,y-1}_{B;D} = \frac{I^{y,6}_{B;D}}{I^{y-1,6}_{B;D}} - 1 = \left(\frac{121.3}{146.6} - 1 \right) \times 100 = -17.3$$

ii) the result for total Z in April (in other words m=4) is

$$D_B^{y,y-1} = \frac{I_B^{y,4}}{I_B^{y-1,4}} - 1 = \left(\frac{108.9}{114.3} - 1\right) \times 100 = -4.7$$

12-month index rate of change

	y							
	Weights	Jan	Feb	Mar	Apr	May	Jun	...
A	0.3	0.8	0.6	0.1	-0.3	-0.3	-1.2	
B	0.2	2.3	1.8	1.8	1.2	0.9	0.2	
C	0.3	-1.9	-3.5	-4.7	-5.4	-5.9	-6.8	
D	0.2	-8.9	-10.6	-14.5	-14.4	-18.0	-17.3	
Z	1.0	-1.9	-3.0	-4.4	-4.7	-6.0	-6.5	

Finally the index rate of change decomposition can be analysed. In the table below, the decomposition for the component indices is calculated by applying the formula [A.8] and the overall index rate of change using the formula [A.4]. For example, taking the component k=A in February (m=2):

$$C_{y-1,2;A}^{y,2} = w_{y,0;A} \times \frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,2}} \times \left(I_{y,0;A}^{y,2} - 1\right)$$

$$+ \frac{w_{y-1,0;A}}{I_{y-1,0}^{y-1,2}} \times \left(I_{y-1,0;A}^{y-1,12} - I_{y-1,0;A}^{y-1,2}\right)$$

$$= 0.306258 \times \frac{111.0}{113.1} \times (99.8 - 100) + \frac{0.304348}{113.1} \times (107.7 - 106.9) \times 100 = 0.1552$$

Similarly, the total Z in May (m=5) is equal to

$$D_{y-1,5}^{y,5} = \frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,5}} I_{y-1,0}^{y,5} - 100 = \frac{111.0}{115.9} \times 98.2 - 100 = -5.9517$$

12-month index rate of change (column) decomposition

	y							
	Weights	Jan	Feb	Mar	Apr	May	Jun	...
A	0.3	0.2	0.2	0.0	-0.1	-0.1	-0.4	
B	0.2	0.4	0.3	0.3	0.2	0.1	0.0	
C	0.3	-0.6	-1.2	-1.6	-1.9	-2.0	-2.3	
D	0.2	-1.8	-2.2	-3.0	-3.0	-4.0	-3.9	
Z	1.0	-1.8	-3.0	-4.4	-4.7	-6.0	-6.5	

The contributions of the components (column decomposition) can be aggregated using the formula [A.6]. If this is done for example for March in year y the rate of change for the total index (Z) is confirmed.

$$C_{y-1,3}^{y,3} = \sum_k C_{y-1,3;k}^{y,3}$$

$$= C^{y,3}_{y-1,3;A} + C^{y,3}_{y-1,3;B} + C^{y,3}_{y-1,3;C} + C^{y,3}_{y-1,3;D}$$

$$= 0.0236 + 0.2620 - 1.5957 - 3.0307 = -4.3977$$

A further feature of this approach is the row-decomposition of the index rate of change whereby this is separated into two (additive) parts, one measuring how much of the index rate of change is due to the current year (α) and the other measuring how much is inherited from the previous one (ß). The results are shown in the following table. For example, using the component B, in February (m=2) of year y the contribution can be decomposed as follows.

$$C^{y,2}_{y-1,m;B} = w_{y,0;B} \times \frac{I^{y-1,12}_{y-1,0}}{I^{y-1,2}_{y-1,0}} \times \left(I^{y,2}_{y,0;B} - 100 \right) + \frac{w_{y-1,0;B}}{I^{y-1,2}_{y-1,0}} \times \left(I^{y-1,12}_{y-1,0;B} - I^{y-1,2}_{y-1,0;B} \right)$$

$$= C^{y,2}_{y-1,m;B}(\alpha) + C^{y,2}_{y-1,m;B}(\beta)$$

$$= 0.165758 \times \frac{111.0}{113.1} \times (99.7 - 100) + \frac{0.161747}{113.1} \times (110.1 - 107.9)$$

$$= -0.0488 + 0.3146 = 0.2658$$

12-month index rate of change (row) decomposition

	Jan		Feb		Mar		Apr		May		Jun	
	α	ß	α	ß	α	ß	α	ß	α	ß	α	ß
A	-0.0303	0.2710	-0.0601	0.2153	-0.0298	0.0534	-0.0892	0.0000	-0.1173	0.0263	-0.1740	-0.1818
B	0.0000	0.3601	-0.0488	0.3146	-0.0646	0.3266	-0.0966	0.2830	-0.1270	0.2652	-0.1570	0.1794
C	-0.5868	-0.0631	-0.8569	-0.3446	-1.1912	-0.4044	-1.2549	-0.6200	-1.2710	-0.7338	-1.2569	-1.0582
D	-0.0707	-1.7748	-0.1579	-2.0480	-0.5400	-2.4907	-0.4340	-2.5920	-0.2054	-3.7801	0.3724	-4.2744
Z	-0.6919	-1.1576	-1.1777	-1.8568	-1.8516	-2.5461	-1.8451	-2.8871	-1.7239	-4.2278	-1.2312	-5.2901

Chapter 9 Revisions

Introduction

The PPI is one of the STS indicators which is least affected by revisions. The 2011 Report from the Commission to the European Parliament and the Council concerning Short-Term Statistics has a special section dedicated to the revision of the STS indicators. The average absolute revision for the domestic PPI for the EU as a whole was 0.1 % for data covering the period from June 2007 to December 2010.

A study carried out in 2006/2007 (the PEEIs in focus summary for the domestic producer price index) found that 12 Member States do not revise their domestic PPI at all and half of the 14 Member States that do revise this index do so only once.

Recommendations

The members of the short-term statistics working group agreed on a series of recommendations relating to short-term statistics. The last review of these recommendations was made at the working group meeting in December 2008. Among other aspects, these recommendations concern a common information policy on STS data revisions. Concerning revisions these recommendations could be summarised as follows:

- the PPIs can be revised;
- in case of important revisions, Eurostat must be informed about the reasons of the revisions and be given the possibility to also inform its users.

Abbreviations

Geographical aggregates and country codes

EU	European Union
EU-27	European Union of 27 Member States
EA-17	Euro area of 17 countries

Member States (in protocol order)

BE	Belgium
BG	Bulgaria
CZ	the Czech Republic
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
EL	Greece
ES	Spain
FR	France
IT	Italy
CY	Cyprus
LV	Latvia
LT	Lithuania
LU	Luxembourg
HU	Hungary
MT	Malta
NL	Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden
UK	United Kingdom

Non-member countries (in alphabetical order)

HR	Croatia
NO	Norway
CH	Switzerland
TR	Turkey

Other abbreviations and acronyms

A/B/C	classification of pricing methods
ABS	anti-lock braking system
BGN	Bulgarian lev
BPM	IMF's balance of payments and international investment position manual
CD	compact disc
CENEX	centres and networks of excellence
CN	combined nomenclature
CPA	statistical classification of products by activity
CPC	central product classification
CPI	consumer price index
CZ-CPA	Czech Republic version of CPA
DKK	Danish krone
DVD	digital versatile disc
EA	elementary aggregate
EC	European Community
EEC	European Economic Community
FOB	free on board
GB	gigabyte
GDP	gross domestic product
GHz	gigahertz
GP	German product classification (Güterverzeichnis für Produktionsstatistiken)
HCSO	Hungarian Central Statistical Office
HDD	hard-disk drive
HICP	harmonised index of consumer prices
HS	harmonised commodity description and coding system
ID	Identification
IMF	International Monetary Fund
ISIC	international standard industrial classification of all economic activities
ISTAT	Italian statistics office
IT	information technology
KAU	kind of activity unit
LTL	Lithuanian litas
LVL	Latvian lats
MB	megabyte
MCR	monthly chaining and resampling
MIG	main industrial grouping
MUICP	monetary union index of consumer prices
NACE	statistical classification of economic activities in the European Community (NACE stands for Nomenclature générale des activités économiques dans les Communautés européennes)
NIP	Slovenian nomenclature of industrial products
OECD	Organisation for economic cooperation and development
ONS	Office for National Statistics (United Kingdom)
ÖPRODCOM	Austrian version of the Prodcom list
PEEI	principal European economic indicators
PPI	producer price index
PPS	probability proportional to size
ProdFra	French version of the Prodcom list
R&D	research and development
RAM	random access memory
SBS	structural business statistics
SKK	Slovak koruna

SNA	system of national accounts
STS	short-term statistics
SVGA	super video graphics array
TDE	touchtone data entry
TFT	thin-film transistor
UN	United Nations
VAT	value added tax
VGA	video graphics array
WZ	German activity classification (Klassifikation der Wirtschaftszweige)

Symbols (used in tables)

~	approximately
:	not available

Classifications (extracts)

NACE Rev. 1.1 (statistical classification of economic activities in the European Community)

A: Agriculture, hunting and forestry
B: Fishing
C: Mining and quarrying
D: Manufacturing
E: Electricity, gas and water supply
F: Construction
G: Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H: Hotels and restaurants
I: Transport, storage and communication
J: Financial intermediation
K: Real estate, renting and business activities
L: Public administration and defence; compulsory social security
M: Education
N: Health and social work
O: Other community, social and personal service activities
P: Activities of households
Q: Extra-territorial organisations and bodies

A full listing of the NACE Rev. 1.1 classification is accessible on the Eurostat website (http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=ACT_OTH_BUILD_TREE&StrNom=NACE_1_1&StrLanguageCode=EN).

NACE Rev. 2 (statistical classification of economic activities in the European Community)

A: Agriculture, forestry and fishing
B: Mining and quarrying
C: Manufacturing
D: Electricity, gas, steam and air conditioning supply
E: Water supply; sewerage, waste management and remediation activities
F: Construction
G: Wholesale and retail trade; repair of motor vehicles and motorcycles
H: Transportation and storage
I: Accommodation and food service activities
J: Information and communication
K: Financial and insurance activities
L: Real estate activities
M: Professional, scientific and technical activities
N: Administrative and support service activities
O: Public administration and defence; compulsory social security
P: Education
Q: Human health and social work activities
R: Arts, entertainment and recreation
S: Other service activities
T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U: Activities of extraterritorial organisations and bodies

A full listing of the NACE Rev. 2 classification is accessible on the Eurostat website (http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN).

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