

Chapter 3. Practical aspects of the development process

Each service industry presents a unique set of challenges to identifying and pricing service products. The purpose of this chapter is to outline, in a practical way, how to develop SPPIs.

The main steps in developing a price index for a service industry are presented in box 3.1. Each of these steps is further discussed in this chapter.¹ For ease of presentation the process is described here in a linear form. In practice it might be necessary to omit or repeat certain steps, to change their order or to undertake some tasks simultaneously.

Box 3.1. Main phases of the development process

1. Preparatory work

- 1.1. Review of literature (SPPI Guide, Voorburg Group papers, PPI Manual, etc.)
- 1.2. Discussions with industry representative organisations
- 1.3. Industry description
- 1.4. Setting the objectives and scope

2. Designing the weighting pattern and sample

- 2.1. The weighting pattern
- 2.2. Designing the sample

3. Respondent initialisation phase

- 3.1. The initialisation process
- 3.2. The initialisation questionnaire
- 3.3. Transaction specification

4. Set-up of permanent framework

- 4.1. Ongoing price collection
- 4.2. Treatment of quality change
- 4.3. Index calculation
- 4.4. Quality assessment and maintenance

The entire process of establishing an index and relevant sub-indices (from the first conceptual phase to the publication) for a specific service industry can take up to 2 years. In box 3.2., a stylised timetable is presented. The example is based on timetables for grant agreements that Eurostat concluded with several European national statistical institutes for the development of SPPIs.

Box 3.2. Timetable for developing an SPPI – hypothetical example

Month:	Action:
• 1 – 2:	- Preparatory work: Literature research, identification of industry representative organisations, collection of data on size and structure of the industry;
• 3 – 5:	- Discussion with representative organisations and with users of statistics; - Visits to enterprises;
• 6 – 7:	- Industry description; - Collection of addresses for pilot survey;
• 8 – 13:	- Pilot study (dispatch of pilot questionnaires, contact with respondents to explain questionnaire, collection of results, evaluation, decisions concerning final sample design etc.);
• 13 – 14:	- Finalisation of questionnaires, drawing of sample, dispatch of questionnaires;
• 15 – 20:	- Data collection, control of response rate, reminders, compiling indices;
• 21 – 22:	- Evaluation of data quality;
• 23 – 24:	- Publication of index, evaluation of feedback from users.

3.1. Preparatory work

3.1.1. Review of literature

The development of a new SPPI should begin with a review of the relevant literature. In addition to the PPI Manual and this Guide, material published by the Voorburg Group on Services Statistics is especially useful. The primary objectives of the Voorburg Group are the proper identification and definition of services industries, products and measures of turnover combined with a coordinated effort to compile producer price indices for use as deflators in order to improve the measurement of services components of GDP at constant prices. The Voorburg Group has published papers on a considerable number of Services sectors which are available on its website.² The “Sector Papers” and “Revisited Sector Papers” will be particularly relevant to index developers.

3.1.2. Discussions with industry representative organisations

Early and effective contact with industry representative organisations can have a positive impact on the quality of indices. Even where the compiler develops an overview of the industry before meeting with the representative organisations, consultation with these organisations is important for the development of a high quality price index. This consultation may help compilers to better understand the industry by providing advice in respect of drafting product specifications, pricing mechanisms and changes occurring within the industry. It may also help to identify problems that can be encountered in the compilation of an SPPI for the industry. Industry representative organisations may assist with forming a more detailed sampling frame (if necessary) and encourage establishments to participate in the survey.

3.1.3. Industry Description

The primary output of the preliminary research and consultation process will be a description of the industry³ upon which subsequent methodological decisions can be

based. This description may have different forms; sample information that should be included is presented in box 3.3.

Box 3.3. Industry description

1. Identification of industry representative organisations (type of businesses represented, tasks of the organisation, contact persons);
2. Detailed review of any previous structural business surveys or other surveys on the industry undertaken by the respective national statistical institute;
3. Overview of methods used in other countries to produce SPPIs for the particular industry, overview of other methodological information (*e.g.* Sector Papers produced by the Voorburg Group on Services Statistics);
4. Scope of the industry (including secondary activities);
5. Size of the industry (revenue, value added, employment);
6. Structure of the industry (share of large and small business enterprises, regional distribution);
7. Description of the industry's service products and their destinations (*e.g.* export, BtoB);
8. Description of where service outputs are used (information that might be extracted from supply and use tables);
9. Description of pricing mechanisms employed for different industries or service products;
10. Identification of possible sources of turnover data at service product and enterprise level (if additional to Structural Business Statistics);
11. Distribution of revenue between different service products.

This industry description will help to inform decisions concerning the objectives and scope of the index and the pricing methods to be used. It should also provide initial information on how to divide the service products into the main groups and how these groups could be weighted together to obtain the total aggregate of this service industry.

3.2. Setting the objectives and scope

The objectives and scope of the new index must be determined. A number of considerations have already been reviewed in chapter 1 and these should be discussed with users, both internal and external. Even where an index is introduced in response to a legal requirement that already specifies scope, periodicity and other central aspects, it can be useful to discuss methodological and practical questions with other future users of the index.

As noted in chapter 1, the scope of the index should, in theory, cover services provided for all uses, intermediate and domestic final consumption, and for exports. Ideally, separate SPPIs should be available for each of these use categories, reflecting the fact that prices, and price movements, may discriminate between users.

A choice must be made between SPPIs which measure change in the prices of products (product based) or industries (industry based). This *Guide* gives preference to product based SPPIs although in practice industry based SPPIs are also more commonly compiled.

3.3. Designing the weighting pattern and sample

3.3.1. The weighting pattern

SPPIs are compiled by progressively weighting price observations through successive levels of aggregation, following the chosen classification structure. There are two phases to the weighting pattern. The first phase combines individual prices to create lower level indices (or elementary aggregates). In the second phase these lower level indices are combined to form upper-level indices.

During the first phase of weighting it is recommended to use explicit weights, in other words weights that reflect the relative importance of the sampled items. This means for example, that each price observation (transaction) will be assigned a weight based on its share of sales of a product. In order to use explicit weights, product value or sales data will need to be collected, usually during the respondent initialisation process. Ideally, lower level weights will not be fixed over any predetermined period thereby allowing for flexibility in updating the sample of transactions and their weights thereby keeping the index representative.

Upper level indices are compiled by weighting together lower level indices through progressive levels of aggregation defined by the classification structure, usually employing weights for a fixed period (say one, three or five years) between index reweighting.⁴

There are a number of potential data sources for use as upper level weights, including; structural business/industry surveys, economic census, input-output tables and international trade statistics.⁵

If a product classification can be determined within a service industry (*e.g.* defined at 4-digit level) or across various industries, then this classification can be used to form an elementary aggregate ("family tree") structure. This classification might sometimes originate from an existing classification or from a specific survey but it may also be based on the advice of the relevant industry representative organisations. Each of these elementary aggregate components is weighted according to the estimated proportion of sales for these products within the industry. Using this approach, surveyed units will contribute one or more sample price relatives to the elementary aggregate structure.⁶

3.3.2. The sample⁷

3.3.2.1. Sampling techniques

SPPI compilers must consider sample design in respect of the selection of both producers and service products (transactions). The methodology or methodologies employed must be based on a consideration of the objectives of the survey (as a national accounts deflator or a general indicator of inflation), the availability and quality of data from which the sample will be drawn and also the level of resources allocated to the survey.

The *PPI Manual* (chapter 5, sections 5.7- 5.13) considers a series of questions and answers which will guide the compiler in determining which sampling methodology should be adopted.

The sampling methodologies employed can be probability or non-probability based. In the case of probability sampling, each producer and service product is drawn from a

known universe and has a known chance of selection. There are two advantages to using a probability based sample. Producers and/or service products (transactions) are chosen impartially and it is possible to measure the quality of the survey through estimation of variance or sampling error.

Probability sampling can take the form of simple random, systematic or probability proportional to size (PPS) sampling. It can be supplemented by clustering or stratification techniques to improve survey efficiency. For SPPI compilation in the U.S., units are stratified by size and PPS sampling is then applied to each stratum to select reporting units. A set of representative service products is selected using a PPS sampling technique called *disaggregation*. With this process, each sampled establishment is asked to report the turnover they generate from the sales of service products within designated categories. Probabilities of selection are assigned to each category based on these turnover values. The categories selected are broken into additional detail in subsequent stages, until unique service products (transactions) are selected and specified for pricing.

In practice however, non-probability sampling is often employed, usually where insufficient data is available to establish the full universe of producers and service products or where the organisation of an industry is concentrated among a small number of large business enterprises.

In non-probability sampling (also known as judgemental or purposive sampling) the sample is chosen, with the aim of being representative, by expert judgement. It is more difficult to estimate the quality of the survey, in respect of both results and analysis of the efficiency of the sample selection, when non-probability sampling is adopted.

Cut-off sampling is a commonly employed non-probability based sampling method. In this method all units at or above a chosen threshold (usually in terms of size) will be included in the sample. While this will generally ensure a high degree of coverage among larger units it may introduce a bias into the index where smaller units have different price movements.

A combination of both probability and non-probability sampling may also be employed. For example, PPS sampling may be employed in the selection of service producers while the most representative service products for each of these producers may be purposively selected.

While the use of probability based sampling has advantages in respect of impartiality of selection and calculation of sampling error, it should be borne in mind that the risks in not employing probability sampling are relatively low in the compilation of price indices.⁸

That said, service industries often have low concentration ratios – there are many service producers and even where there are some larger units they only account for a relatively small proportion of output. In these industries there is a stronger case for using probability based sampling.⁹

3.3.2.2. *Sampling frame*

The situation concerning possible sampling frames may vary considerably from country to country. In many countries the business register or national accounts provide a source of sampling frames. Business registers normally have information on revenue (or turnover) and the number of employees. However, they are usually not detailed enough to provide information at the level of establishments (local kind of activity units) or revenue

information by service categories. An additional survey may therefore be needed to derive reliable weights for establishments or the main service product groups for the industry. This survey takes place during the respondent initialisation process and is discussed under section 3.4. Industry representative organisations, regulatory authorities or market studies carried out by third parties may give additional information. In extreme cases the frame might be structured on the basis of information obtained from alternative sources such as the telephone directory or the internet.

Ideally, the sample frame should include all producing units (including those exporting) within the geographic and industry coverage required and should be updated instantly with births and deaths and any changes to contact details.¹⁰

3.3.2.3. *Sampling structure*

The choice of sampling structure will largely depend on what information is available in the sampling frame and on whether industry or product level statistics are required.

For industry based SPPIs, firstly each establishment is classified to a 4-digit ISIC or NACE heading based on its principal activity. A sample of establishments is then drawn from within each heading and a selection of representative transactions is priced from each sampled unit. All output of these sampled units is represented in theory (even secondary activity output classified under other industries) and aggregated to form these 4-digit industry level indices.

Product based SPPIs are created from samples of products and so should, in theory, be compiled on the basis of output information at product level from each establishment. This information is used to compile lists of producers of each product. All service product output (obtained from lists of producers of each product) is eligible for selection, regardless of the classification of the establishments that produce it. A sample of transactions is drawn from each list and these transactions are weighted to form product group or product class level indices (following the CPC terminology) and can also be aggregated to 4-digit industry level indices. It is unlikely however, at least in the case of the services sector, that sample frames will have sufficient detail at product level to allow for this approach.

Approximate product based SPPIs are compiled from samples of establishments for multiple industries. Firstly, each unit is classified to a 4-digit industry based on its principal activity. Each industry frame is then stratified by size of unit and samples are selected from each of these strata (*i.e.* probability proportionate to size sampling for the industry). Transactions are selected from each unit, using either probability or purposive based techniques, and these are assigned to their relevant product area. Product level SPPIs can then be calculated by weighting transactions on the basis of their product heading, irrespective of the industry in which the units are classified (“wherever made”). Industry based indices can also be produced by weighting the transactions on the basis of the industry in which they are produced (“whatever made”). While product level SPPIs compiled using this option may not be as accurate as those compiled from direct sampling of products it has the advantage of not requiring the sample frame to contain detailed information on the volume of services produced at product level.

3.4. Respondent initialisation phase

3.4.1. *The initialisation process*¹¹

Detailed service product (characteristics) and price data are required to produce high quality price indices and the collection of these data can be difficult and expensive. The initialisation process must be detailed and precise even when resources are constrained. Ideally, initialisation of new respondents should involve a personal visit. Where this is not possible the initialisation may require pre-contact research, telephone calls and a dedicated (initialisation) questionnaire.

The initialisation process should include the ten following activities. Where personal visits are possible these may focus on activities 5-7.

1. Research: The initialisation team researches each sample unit/establishment that is being introduced as a result of new samples. This research will cover business activity, products sold, pricing mechanisms, type of customers, etc. A combination of tools including the business register, the internet, industry publications, etc. will be used to thoroughly research the sampling unit and the related business activity;
2. Verification: The team is required to verify the contact information for each establishment. This may require cross referencing information with other surveys being conducted within the National Statistical Institute;
3. Initial contact: The establishment is provided with an introduction to the SPPI survey, including an explanation of the survey purpose, uses of survey data, reporting requirements and the steps involved in the survey initialisation process;
4. “Best” contact: The “best” contact that is able to report data on behalf of the establishment sampled is identified. It may take a number of attempts and some effort to identify the best person in the establishment to provide the price data that is required. This is usually the case for larger units that may have sales, marketing and accounting departments;
5. Products and/or specifications and initialisation questionnaire: Once the “best” contact has been identified, the initialisation team works with this respondent to explain, discuss and identify the products to be reported and the detailed product specifications and/or pricing mechanisms to be used. The development of the initialisation questionnaire is discussed in more detail under section 3.4.2.;
6. Initialisation questionnaire mail-out: After a contact has been identified and the products to be reported and/or pricing mechanisms selected, the initialisation team mails out a customised initialisation questionnaire and reporting guide to the respondent;
7. Initialisation follow-up: The initialisation team schedules telephone follow-up with the respondent to ensure that they have received the initialisation questionnaire and to respond to any queries or questions they may have;
8. Collection of initialisation questionnaire data: The initialisation team ensures that the initialisation is completed and returned by the respondent in a timely manner;
9. Data analysis: The initialisation questionnaire data is verified to ensure that it is correct and that it makes sense;

10. Assignment of initialised units to centralised collection for ongoing collection: After it has returned a correctly completed initialisation questionnaire, the respondent is transferred to centralised collection for ongoing collection. The initialisation team member responsible for initialising the respondent also reviews the first regular return made by the respondent to ensure that it is acceptable;

Specialised training on specific aspects of the survey, including pricing mechanisms and concepts should be provided to the initialisation team and the centralised collection team as required.

3.4.2. *Initialisation questionnaire*

In order to identify, collect, track and analyse the specific services that must be re-priced over time, a separate initialisation questionnaire is used to introduce new sample units/products. This should be designed to minimise respondent burden while also ensuring the required information can be accurately reported and collected. The initialisation questionnaire will include detail on:

- Business activity: Confirmation of services activities;
- Service product lines/Departments: Based on sales revenue, identify the main product lines or departments and their respective share of total sales;
- Destination - Services for export: Where export sales of product lines/department export sales are sufficiently large, prices for representative export transactions should be included – again with their share of sales;
- Transactions: Specification of most representative transactions sold by the sampling unit. These should be classified within service product lines or departments. Specifications should be detailed enough to allow respondents to report constant quality prices for them. They should also include their share of total product line or department sales to allow for weighting of individual prices. Transaction specification is discussed in more detail in the following section.

3.4.3. *Transaction specification*

The target is to select transactions to represent all service product lines (primary and secondary); however, it is also important to balance the need for these data with response burden. The *PPI Manual* suggests that the average number of prices collected from each establishment should be around 4 or 5. This is only a guide, but it does serve to minimise burden. If the number of transaction specifications exceeds 15-20 per establishment, it is recommended in the manual to combine product lines in a way that seems reasonable. For product lines with very low weights, it is either advisable to combine these with another product line or to ignore them and redistribute the weight.

The purpose of a detailed service transaction specification is to ensure that a consistent price is collected from period to period, relating to the same service with the same terms of sale in each period. It will also facilitate the adjustment of prices for services which change in quality over time.¹² Box 3.4. lists some of the criteria that could affect the price of a service and therefore might form part of a specification. The pricing mechanism employed by the respondent, and the pricing method chosen in response, will significantly influence the service specification. The list is not comprehensive and additional criteria may be required in different service industries or business enterprises.¹³

Box 3.4. Service specification – example

Specification:	Explanation:
• Name of service	- Respondent's name for the service within the specific service group.
• Description and coverage of the service	- The respondent should specify in detail what the service includes.
• Unit of sale	- Units used in describing the service (for example minutes, hours, entries, documents or tasks).
• Customer	- Pricing structure might depend on customer (or the size category of the customer). A reference number can be used to maintain customer confidentiality.
• Discounts/Rebates	- All applicable discounts/rebates should be described.
• Location	- The price of the service may depend on the place where it is supplied (including export markets).
• Time	- The price of a service may depend on the time when it is delivered (e.g. week-end or working day).
• Payment terms	- Different payment or credit terms may result in different prices.
• Currency	- Currency fluctuations may significantly alter the price received by the service provider.

3.5. Set-up of permanent framework**3.5.1. Ongoing price collection**

Ongoing price collection should be conducted with customised forms, detailing the specifications of the transactions selected for pricing and taking account of the pricing method to be employed. As previously noted, prices reported should be actual market transaction prices.

Price observations should undergo both input and output editing. Input editing refers to edit checks on individual price observations and often involves setting tolerances around price changes. Price changes that are larger than a set threshold (for example, +/- 5%) may be checked for an accompanying explanation or queried with respondents where necessary. Output editing refers to editing by comparison of price movement of similar products. Outliers (price observations which appear inconsistent with other prices) should be identified and checked.

In addition there should also be a check for prolonged non-movement of prices. Price change can be more or less frequent in different industries and consequently different tolerances for prolonged non-movement of prices may be employed.

It is also recommended to periodically check indices against alternative sources of information on price development within industries. This may involve analysis of similar price measures or media reports. Industry representative organisations may also be able to provide good market intelligence.

3.5.2. Treatment of quality change

A challenge for collecting price data for services (and goods) is that the products bought and sold change over time. Firstly, specific services exchanged between a producer and a customer may change (e.g. a service is delivered in less time or by a better

qualified employee of the service producer). This is referred to as the problem of quality change. Secondly, the composition of services that are exchanged in a certain service industry will vary over time. It is important therefore to ensure that the transactions selected for pricing, and their respective weights remain representative.

The overarching principle for the treatment of quality change is that "at the most detailed level, the prices of items between any two periods may be directly compared only if the items are essentially the same".¹⁴ Two services (of a certain nature) are assumed to be of the same quality if at a given time they are exchanged for the same price. Theoretically the quality of a service is defined by a number of dimensions which are on the one hand of importance to the user and his willingness to pay for the service (known as the user-value approach) and on the other hand of importance to the seller and the costs that he has to bear to produce the service (known as the production-cost approach).¹⁵ As a rule, there is a case for quality adjustment if clients are willing to pay more for a changed service or if they are no longer willing to pay the former price.

The practical assessment of service qualities is often problematic since observed differences in prices for two services that appear to be the same might exist for a number of reasons (*e.g.* market imperfections). Even if it can be assumed that price differences are related to quality differences, it might not be known which dimensions of the quality are in fact responsible for the differences. Finally, even when the differences in two services are known, it may still be difficult to separate the price changes due to the quality change from the genuine price change that a price index should reflect.

To the extent that the quality of a product depends on factors that cannot be directly observed (*e.g.* the preferences of the customers), drafting a description of a product which includes all the various quality aspects will be an approximation. However, in the case of (physical) goods such a description can be assembled with more confidence than in the case of services. For example, for agricultural products quality classes have been defined that guarantee a high degree of homogeneity for products within one class. In the case of technical products like computers, quality aspects that play an important role in the price setting between buyers and sellers can be objectively defined and measured (storage capacity, speed etc.). For services however, this is much more difficult. Services might differ in ways that cannot easily be observed by the compiler. Services are often much more complex than goods (*e.g.* giving legal advice or management consulting) and services might be unique, *i.e.* tailor-made for one occasion and/or for one customer. Finally, quality changes in services are not systematic; they might represent improvements or deteriorations.

As a consequence, some degree of subjectivity on the part of the compiler measuring quality change in services cannot be avoided. Therefore, it is of great importance that the reasons and methods employed are well documented.

There are frequent needs for quality adjustments and replacement of transactions for ongoing pricing. These should be an important consideration in the design of questionnaires and survey process and methodologies. The following issues should also be discussed with representative organisations and/or respondents when the survey is being developed:

1. Expected changes in the representativeness of services over time;
2. Expected changes in the quality of services;
3. Quality adjustment methods to be considered; and

4. Data availability for implementing quality adjustments.

Chapter 7 of the *PPI Manual* discusses various quality adjustment methods in detail. Because of the very specific nature of certain services, only some of the methods may be applicable for some service industries.

Each method for quality adjusting has advantages and disadvantages. The choice between various methods depends on service characteristics and data availability.

The following section summarises the main points contained in chapter 7 of the *PPI Manual* and in the *OECD's Handbook on hedonic indexes and quality adjustments in price indexes*.¹⁶

3.5.2.1. Direct comparison / comparable replacement¹⁷

In the simplest case, it may be assumed (either with input from the respondent or through analyst judgement) that there are no relevant differences in the quality of an old and a new service product. In such a case, the direct comparison method (an implicit method of quality adjustment) will be used, *i.e.* the price of the new service products will be incorporated into the index without any adjustment and the prices for the new and the old services will be directly compared because it has been determined that there is no change in quality. A typical example of such a case is a change to the name of a service product or producer without a change of the service itself.

3.5.2.2. Overlap method¹⁸

The overlap method can be applied when old and new service products are transacted simultaneously during a certain period of time making it possible to use observations in the overlapping period as a link. The implicit assumption in the method is that the price difference between the old and new products reflects entirely differences in quality.

Box 3.5. Overlap method – example

In period 1, the price of the old service is €100. In period 2, a similar but new service is exchanged for the first time for €108; the old service is still exchanged but the price is now €90. The old and new services are largely the same, yet the new service is delivered faster. It is assumed that the relative price difference between old and new service ($1.2 = €108/€90$) represents the price increase due to the better (faster) service. In period 3, the old service is no longer provided. The price of the new service in period 3 is €144. In order to make all three periods comparable, the new service price in period 3 is corrected using the quality factor identified in the overlap period.

Period 1	Period 2	Period 3
$P_{old} = €100$	$P_{old} = €90$	$P_{old} = n. a.$
$P_{new} = n. a.$	$P_{new} = €108$	$P_{new} = €144$
	Quality factor: $1.2 (€108/€90)$	
$P = €100$	$P = €90 (€108/1.2)$	$P = €120 (€144/1.2)$
	$\Delta p = -10\% (€90/€100)$	$\Delta p = 33.33\% (€120/€90)$

The use of the overlap method is restricted to cases where there are old and new products that are sufficiently comparable to assume that price differences between them are quality related and where a change in quality indeed can be assumed to have occurred. A problem arises with the method when the markets for the old and the new product are not in equilibrium and so the entire price difference may not be resulting from quality

change. In the above example, if the old service in period 2 could only be sold with a rebate because of the competition from the new service then the quality factor would be too high.

In a more extreme case, it might also happen that a service producer increases the price of the old service to deter customers from buying it and offers the new service at preferable terms to promote it. While the new service might actually be better than the old (providing increased utility to the customer), the quality factor could indicate a deterioration in quality.

A typical situation requiring the use of the overlap method is the rotation of products in a sample. For example, consider the case of outdoor advertising. The price of an advertisement is specified based on size and location. If the advertisement expires, the sample price is replaced by another. In this case, the overlap method can be used providing that the new sample price has coexisted with the old one and the price difference between them has been relatively stable in the past.

3.5.2.3. Bridged overlap method¹⁹

The overlap method requires transactions of the old and the new service during the same period, so that it is possible to collect comparable prices for both services. Where comparable prices in a common period cannot be identified, the price development of similar services (to both the replaced service and the replacement service) can be used to distinguish pure price changes from changes that are due to a different quality.

In the bridged overlap method the difference between the price of the old and the new service is compared with average price changes in similar services. If the price change between the old and the new services is different from the average price change of these "reference services" the difference is assumed to reflect a change in quality.

Box 3.6. Bridged overlap method – example

In period 1, service A is provided for €100. In period 2, the service is replaced by an improved service B which costs €120. Services C and D are in many respects similar to services A and B. Their respective qualities remain unchanged between period 1 and 2 but both prices (and thus the average price of these reference services) increase by 15%.

It is therefore assumed that the price increase of 20% between service A (in period 1) and service B (in period 2) is made up of a pure price increase of 15% and a quality element of 5%.

3.5.2.4. Quantity adjustment²⁰

Quantity adjustments are used in cases where the specification of service products is based on certain measureable standards. To be applicable, it is also important that fixed costs of service provision are relatively small. In these cases, prices can sometimes be expressed as unit prices, which make it possible to establish price comparison between periods.

Examples of these kinds of services are taxi transportation and newspaper advertising, where prices are established based on given standards. The method should however, be applied with caution and only if changes in standards are relatively modest.

Box 3.7. Quantity adjustment – example

In period 1, a weekly cleaning service is provided for a customer with office space of 1,000 square metres. The total price is €20,000. In period 2, the customer has rented additional offices of 200 square metres and the service provider now charges a total of €25,200.

$P_1 = €20,000$ for 1,000 square metres, i.e. €20 per square metre

$P_2 = €25,200$ for 1,200 square metres, i.e. €21 per square metre

$P_2 / P_1 = 21/20 = 1.05$, i.e. prices have increased by 5%

3.5.2.5. Differences in production and option costs²¹

The production-option cost method requires information about the additional cost (or cost savings) for the producer that accrues when an old service is replaced by a new one. The central assumption of this approach is that the changes in production costs reflect directly the quality difference between the old service and its replacement.

Box 3.8. Differences in production and option costs – example

In period 1, a certain service is provided for the price of €1,000. In period 2, the price increases to €1,100. However, some quality aspect of the service changes as well (e.g. shorter time for service delivery, higher frequency, or service provided by better trained personnel). According to the service producer, the increased quality has generated additional cost of €130.

The pure change in prices is therefore: $(P_2 - \text{add. cost}) / P_1 = (€1,100 - €130 / €1,000) = 0.97$, i.e. the price decreased by 3%.

The method is applicable for services that undergo simple changes rather than change in respect of service content. While there are some similarities with the quantity method the additional quality of the service is not necessarily limited to some measurable dimension of the service (such as size, frequency etc.).

3.5.2.6. Hedonic approach²²

The hedonic approach is typically used for products that are under rapid development and where sufficiently representative and robust prices cannot be found to cover overlapping periods. Instead of relying directly on prices of new and old products, a price comparison is established on the basis of the individual characteristics of products.

In market equilibrium and perfect competition, prices should reflect the importance of various characteristics of products. This makes it possible to use actual data for identifying price determining factors and for establishing a regression model. The model can then be used for estimating an overall quality change of products whose characteristics change over time. It should be noted however, that the hedonic approach requires a large pool of observation of prices and price determining characteristics.

Price determining factors for services can be difficult to identify or to measure, and therefore the hedonic method is rarely directly applicable. However, it might be used indirectly, namely in cases when services are related to goods for which price changes are estimated using the hedonic approach (such as rental of computers).

3.5.3. Index calculation

The index formula chosen for the elementary aggregates²³ can vary as a function of the sampling method, information available, specific nature of industry, and resource restrictions. A more extensive description of widely used elementary aggregate formulas and their justification can be found in chapter 20 of the *PPI Manual*.

It is recommended that where possible, explicit weights are used at all levels of aggregation. When aggregating sample price relatives²⁴ within elementary aggregates, geometric averaging should be used when weights are not available.

The index number formula used in the aggregation of elementary aggregates should be selected as a function of the indicator's purpose. Individual countries may have different priorities and the formulas may therefore differ from country to country. In general, it is recommended that the European Union member states should use a Laspeyres-type index formula that is in line with the EU short-term statistics regulation, which specifies all relevant aspects of the collection of service producer prices in the EU.²⁵

The modified Laspeyres (short-term formulation) has a number of advantages over the standard Laspeyres (long-term formulation) in calculating the SPPI. The short-term formulation weights each short-term price relative (current price compared with previous period price) by its previous expenditure share (weight in previous period). The previous period expenditure share is equivalent to the base period value share, updated for price change to the previous period, thus providing a better representation of the dynamic nature of the weighting structure. The short-term formulation facilitates the introduction of new transactions without having to impute base period prices. When two successive prices for the replacement transaction are available, it can be used in place of the transaction that is no longer available. If a price is missing, the short-term price change of similar items can be used (as opposed to long-term price changes) for purposes of imputation. Another advantage of the short-term formulation is that it is much easier to deal with quality changes.

The weight of a sample price relative for a certain product or service will reflect the first stage weight (*i.e.* the inverse of its probability of being selected for the sample) of the units in which it is produced and also the share of the turnover of that product in the units' turnover (second stage weight). See box 3.9 below as an example of this weighting methodology.

An advantage of this form of index aggregation is that sub-indices for service products (*i.e.* which form the elementary aggregate structure) are produced which may be a useful output if deemed to be of suitable quality. A potential disadvantage of this method is that it relies on the relevance of the product classification forming the family tree structure. If this phase of the index development has not been done well then the family tree structure may not represent important product groups within the industry and the index could be of low quality.

Box 3.9. Weighting example for product SPPI of 4-digit level industry

An industry survey showed that a particular service industry identified at 4-digit NACE level produces 4 main product groups; y1, y2, y3 and y4 with approximate shares of 20%, 30%, 15% and 35%. This defines the elementary aggregate structure for the SPPI. The total turnover for the industry is 2,360 (the sum of the establishment group turnovers).

5 establishments are chosen in the sample for the industry using probability proportional to size (PPS) sampling. Establishment A was selected from a group of 5 establishments who have a total turnover of 500.⁽¹⁾ Establishment B was selected from a group of 8 establishments who have a total turnover of 560 and so on. Larger establishments are asked to provide up to six price quotations and smaller establishments are asked to provide non more than four. The establishments have the following characteristics:

Establishment (enterprise)	Probability of selection	Turnover	Establishment group turnover	Shares of the main product groups in turnover	Price quotations for each product group
A	1/5	100	500	0.25; 0.25; 0.5; 0	1; 2; 3; 0
B	1/8	70	560	0.7; 0; 0; 0.3	4; 0; 0; 2
C	1/10	40	400	0; 0.4; 0; 0.6	0; 3; 0; 3
D	1/50	10	500	0; 0.5; 0.5; 0	0; 3; 3; 0
E	1/100	4	400	0; 0; 0; 1	0; 0; 0; 4

For each establishment, price quotations (specifications) within a product group have equal weights. Relative weights for each specification are aggregated geometrically to form an establishment level relative weight for the product group. These weight relatives (micro indices) must then be weighted together with other establishments' weight relatives to form the elementary aggregate (i.e. product group) indices.

Product group	Product group weight (product approximate share* total industry turnover)	Establishment	1 st stage weight ⁽²⁾	2 nd stage weight	Total weight (1 st * 2 nd)	Relative Weight within product group
Y1	472	A	5	$100 \times 0.25 = 25$	125	$125 / (125 + 392) = 0.24$
		B	8	$70 \times 0.7 = 49$	392	0.76
Y2	708	A	5	$100 \times 0.25 = 25$	125	0.23
		C	10	$40 \times 0.4 = 16$	160	0.30
		D	50	$10 \times 0.5 = 5$	250	0.47
Y3	354	A	5	$100 \times 0.5 = 50$	250	0.50
		D	50	$10 \times 0.5 = 5$	250	0.50
Y4	826	B	8	$70 \times 0.3 = 21$	168	0.21
		C	10	$40 \times 0.6 = 24$	240	0.30
		E	100	$4 \times 1 = 4$	400	0.49

(1) Under PPS sampling, the probability of an establishment being selected in the sample is proportional to a measure of size for the establishment obtained from the sampling frame (e.g. turnover), i.e. the larger the establishment the higher the chance that it will be included in the sample.

(2) The first stage weight is equal to the inverse of its probability of selection.

3.5.4. *Quality assessment and maintenance*

After a new SPPI for a service industry is compiled, or a pilot survey has been conducted, a quality assessment should be performed. Quality assessments should also be periodically performed on existing indices to ensure they remain representative. The quality assessment procedure is discussed here from two perspectives: firstly, the SPPI is judged as an indicator in its own right (box 3.10) and secondly, as an input into the national accounts (box 3.11).

Box 3.10. Assessment of SPPI for service industry

- Ability to approximate transaction prices;
- Objectivity (*e.g.* preference for actual charge out rates);
- Pricing frequency;
- Continuity (period for which a method can be applied without a change);
- Practicality (for the staff of the statistical offices);
- Response burden (*e.g.* time that a respondent needs to fill in the survey);
- Response rate (number of forms returned divided by number of forms sent out);
- Opinion of the pilot-study respondents;
- Transparency of the method;
- Plausibility of the results.

For a practical evaluation each method is given a certain score for each criterion; for example very positive (++), positive (+), neutral (0), negative (-), very negative (--). Alternatively, points could be distributed; for example very positive (2), positive (1), neutral (0), negative (-1), very negative (-2). Since not all criteria are of equal importance, the criteria might also be given different weights. The evaluation of a method is then the result of the scores and the weights.

There is a certain element of subjectivity in this method, especially for criteria like transparency which can be difficult or sometimes impossible to measure directly (as *e.g.* compared to the response rate). Moreover, the evaluation grid might put more or less emphasis on certain aspects (for example, in the above box the opinion of the pilot-study respondents could be omitted because it could be argued that this information is implicitly contained in the response burden and response rate). Nevertheless this approach has the advantage that the decision in favour or against a certain method can be better justified and that the criteria and their weights can be determined in advance.

Another way of assessing SPPIs is to consider their quality as national accounts deflators. The criteria that are used in the evaluation can be divided into two groups: absolute measures that indicate how reliable the SPPI are in their own right, and relative measures that compare the SPPI to deflators that are used currently. Examples of criteria for absolute measures are presented in box 3.11. The Eurostat *Handbook on price and volume measure in national accounts* provides an example of a relative criteria assessment, classifying methods into A, B or C methods.

Box 3.11. Criteria for evaluating an SPPI as a national accounts deflator

- Statistical properties of the survey;
- The definitions and specifications of the variables (should be in line with the national accounts definitions and specifications);
- Periodicity of data collection, timeliness, and length of the series;
- Quality checks (*e.g.* ability to explain erratic movements) and periodicity of index revisions;
- The transparency and available documentation of the production and quality assessments.

After the quality assessment has been carried out, the necessary actions to improve the survey should be undertaken. In the case of the quality assessment of a pilot survey, full-scale data collection should start only after the improvements are implemented.

The maintenance of service price quality is an important task in the compilation of price indices. Ideally, prices for a representative set of service products could be surveyed from one period to another but in practice the market changes continuously. New services appear and old services disappear, especially in services industries dominated by swift technological changes such as telecommunication. Sometimes services remain unchanged but the pricing mechanism might change and consequently, pricing methods have to be changed. Also, the business demography may change, which can necessitate a revision of the sample frame. For all these reasons, maintaining representativeness of the sample and at the same time capturing pure price changes in the survey data for an SPPI is a challenging task.

The maintenance work of service prices thus includes:

1. Evaluation of the representativeness of service products in the sample;
2. Continuous observation of sample price specifications;
3. Replacement of sample prices.

The use of representative service products and transactions in an SPPI is an essential precondition for correctly monitoring the evolution of prices. Confirmation of sample price specifications is of great importance for ensuring that the prices of the same transactions are followed over time. When sample prices are replaced, quality adjustments should be considered.

The maintenance work has to be done after the periodical price survey starts and within the cycle of the survey period to ensure that data are validated in advance of scheduled publication dates. Since not all survey response is received promptly enough to allow it to be validated within the survey period, published data may need to be revised in later periods to reflect these late reports. To ensure that the maintenance work is performed accurately, efficiently, and in a timely manner, price compilers should be prepared in advance. They will have to reserve time for discussions with respondents and possibly industry associations on changes in the market and possible solutions. Proper preparation for surveys is, in general, time consuming, and it is possible that not enough time is available for all maintenance tasks during the survey periods. Therefore, focusing

on maintenance work outside the non-probability current periodic surveys (e.g. half-annually or annually) is a practice worth considering.

Further information on the maintenance of a price index can found particularly in chapter 8 of the *PPI Manual*.

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Notes

1. This chapter draws heavily on the *PPI Manual* which details ten basic steps to PPI development. See *PPI Manual*, appendix 1.1.
2. See <http://www.voorburggroup.org/>
3. Note that “industry” means here that service products are aggregated to the 4-digit industrial classification. In practice the index usually only covers service products principal to the industry, but in concept should also include secondary production.
4. See *PPI Manual*, par. 1.306.
5. See *PPI Manual*, par. 1.309.
6. Note that a respondent unit will only contribute a specification to a component of the elementary aggregate structure if it has significant production for the particular

service product in question. Thus one does not expect a respondent to contribute specifications to each component of the indices' elementary aggregate structure.

7. This section draws heavily on chapter 5 of the *PPI Manual* which readers should consult for a more in depth discussion.
8. See *PPI Manual*, par. 5.22.
9. See *PPI Manual*, par. 1.320.
10. See *PPI Manual*, par. 5.36.
11. This section is largely based on a note by Draper and Loranger (unpublished) detailing the processes adopted by Statistics Canada in the initialisation of new respondents in price surveys.
12. The treatment of quality change is discussed in more detail under section 3.5.2.
13. For concrete examples of product specifications see the detailed industry chapters in this Guide. Additional information can be found in chapter 10 of the *PPI Manual* which deals with the treatment of specific products, in particular in sections 10.J. (Retail Trade), 10.K. (Telecommunication), 10.L. (Commercial Banking), 10.M. (Insurance), 10.N. (Software, Consultancy and Supply), 10.O. (Legal Services), and 10.P. (General Medical Hospitals).
14. See *PPI Manual*, section 7.2.
15. See *PPI Manual*, section 7.6.
16. See Triplett (2006).
17. See *PPI Manual*, section 7.107.
18. See *PPI Manual*, sections 7.80–7.89.
19. See Destatis (2009), chapter 5.2.5.
20. See *PPI Manual*, sections 7.113 – 7.117.
21. See *PPI Manual*, sections 7.118-7.125.
22. See *PPI Manual*, par. 7.126-7.151.
23. An elementary aggregate is generally the lowest level within an index structure for which reliable weights exist for the population of interest (*e.g.* relatively homogeneous group of service products), generally obtained from some source not directly related to the collection of prices (*e.g.* independent survey). Samples of prices are collected within each elementary aggregate.
24. Sampled price relatives are the micro indices of sampled prices contributing to the elementary aggregate.
25. All legal text concerning EU short-term statistics are available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/short_term_business_statistics/legislation



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