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QUALITY ADJUSTMENT FOR SMALL COUNTRIES
Example Sweden

Session on Quality Effects

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Producer Price Index for Services
Statistics Sweden

Forward

It is easy to forget today that, before 1999, there were no international guidelines on PPI for services, no international conferences for information exchange on the subject and no international legislation to regulate and harmonise the collection of prices of services[1] provided to enterprises. The terminology was not completely defined and there was a common understanding that the CPI could be used as a good "proxy".
In 1999, the UN Statistical Commission asked the Voorburg Group to focus on the measurement of the prices of services provided to enterprises.

Factors contributing to growing development of PPI for services of today:
Support is available in the new PPI manual (2003), in the Handbook on Price and Volume Measures in National Accounts (2001), in existing (field of national accounts: Annex A to Council Regulation 2223/96, Commission Decision of 17 December 2002) and future (field of short-term statistics: Amendment to STS Council and Parliament Regulation 1165/98) applicable regulations within the EU. Development reports are available on the websites of the Voorburg Group and certain countries. The OECD's website contributes, among other things, with links to contacts in different countries. The Voorburg Group Meetings have taken place annually and, since 1999, they discuss methodology of PPI for services within certain chosen service industries, producing a summary document or "principal paper" per industry.
Within the framework of the OECD-Eurostat Task Force on service prices in short-term statistics, which began in 2002, experiences can be shared between different countries and the methodologies used in each country can be reviewed and discussed.
It is planned that the expanded STS manual will contain a section on "Best practices" within PPI for services. Many countries, which are participating in the OECD-Eurostat Task Force on service prices in short-term statistics, are currently involved in preparing this section.
As statistics on services are a priority area, Eurostat offered the possibility of applying for grants for the development of service price indices, both within STS (short-term statistics) and NA. The financing of pilot studies is also helping countries to begin work.

Today many countries are developing new PPI for services. The international regulations, instructions and cooperation facilitate the process. The problem seems to have moved to the production side, where expansion of the number of indices to produce often does not correspond to the allocated economic resources.

[1] Certain services are regarded as economic activities in NACE Rev.1, belonging to group 50 and upwards.

Quality Adjustment for Small Countries - Example Sweden

Treatment of quality changes in services within PPI for services in Sweden

This paper briefly describes the rapid development of the PPI (Producer Price Index) for services in Sweden, the requirements of System of National Accounts for a price index for deflating and selection of procedure for production of PPI for services that best suits the budgets of small countries while maintaining high quality of the final product.

Annex 1 presents more about demand and use of deflators within Swedish national accounts, annex 2 takes up ideal quality considerations in a producer price index and annex 3 treats πps-sampling in general.

Introduction

The Prices unit at Statistics Sweden compiles a number of price indices for services. It also develops new service price indices.
There have been price indices for the following industries since the mid-1990s: Hotels, Scheduled air transport of passengers and Renting or leasing services involving own non-residential property. All of these indices have been reviewed after 2000.
Between 2000 and 2003, **17** new PPI for services have been developed and their production is ongoing. **Six more** indices have been developed since 18th Voorburg Group Meeting and price collection started in 2004.
The first results of **PPI for export of services** are under analysis. The possibilities for enlargement of export indices to other service industries are very exciting and actual issues for planning future work.
The systematic **work with quality adjustment** (using other than the overlapping method) within PPI for services has been going on since 2002.

Current production of PPI for services, number of series in ( ), if more than 1:

55.1	Hotel services (3)
60.24	Freight transportation services by road
62.10.1	Scheduled passenger transportation services by air (2)
63.4	Other transport agency services
64.11	National post services
64.2	Telecommunications services (4)
70.20.12	Renting or leasing services involving own non-residential property (annually)
71.1	Renting services of automobiles
72	Computer and related services (4)
74.11	Legal services
74.12	Accounting, bookkeeping and auditing services (2)
74.2	Architectural, engineering and related technical consultancy services (2)

First year production of PPI for services on:

61	Water freight transportation services
62.10.2	Scheduled freight transportation services by air (2)
64.12	Courier services other than national post services
65.12	Other monetary intermediation services
74.4	Advertising services

The main purpose of developing service price indices is to create producer price indices for services designed for use in the Swedish System of National Accounts for calculating the production values of services at fixed prices at the product group level in concordance with the European Union's recommendations**.** (Private services represent about 50 percent of GDP in Sweden.)

The National Accounts unit of Statistics Sweden has commissioned the development of price indices. This work was carried out in project form at a departmental level from January 2000 to December 2003. The first work, which the project ordered from the cooperating National Accounts unit, was an inventory of the A, B and C methods then used for deflating services (at the product group level). From this inventory, the project was able to gain a clear picture of the number of product groups that awaited an improved deflator. There were over 100 product groups that needed to replace the deflator.

The project has fulfilled its job with success. Since January 2004 the development of new price indices is aimed to continue within the statistical product PPI for services in the Price unit of Statistics Sweden. However, cooperation among experts on price indices, national accountants and specialists on service industries will continue.

The need for continued development of PPI for services will exist for many years, since services are classified according to 120 product groups (of a total of over 400) within the Swedish System of National Accounts. At the same time while this is certain, it is necessary to stress that an NSI (National Statistical Office) in a small country such as Sweden has very limited resources, and the dream of a large organisation that can freely handle production of hundreds of deflators remains a dream.
Thoughts concerning budget restrictions together with the need for enormous amounts of high quality deflators led to the present production procedure.

National accounts' requirements for a price index

The Handbook on Price and Volume Measures in National Accounts, Eurostat (2001), gives international recommendations for the selection of methods for calculating deflators. The handbook classifies different methods of suitability as A, B and C methods. The A method is the most suitable method, the B method is another method that can be used, and the C method is one that should not be used. The handbook gives recommendations on the method selection, specifically for the different product areas and transaction categories.

In general, the handbook says that the A method for deflating of production (output) is to use a producer price index (PPI) that briefly fulfils the following. The price index should refer to the exact product group in question, taking quality changes of products into consideration as well as price concept (known as base price), and be suited to concepts of national accounts. The B method could be to use a PPI, which partly but not fully fulfils these requirements, such as a PPI that is not adjusted for quality changes. These general principles are more specifically developed for special product areas in the handbook.

In the System of National Accounts, services are regarded as equal to goods, and both are called products. The ideal index for fixed price calculations and comparisons among different countries is, according to ESA (European System of National Accounts) 1995 chapter 10, Fisher's index formula. However, the Fisher formula has the disadvantage that it is not additive, not even for the year closest to the base year. Therefore, the Paasche price index and the Laspeyres volume index are preferable to Fisher. The same chapter admits, however, that other types of price index can be used for shorter time comparisons, i.e. month or quarter. In general, changes in a transaction value must be referred to either as a price change, a volume change or a combination of the two.

For transactions in services, it is often difficult to specify the characteristics that determine the services, since services vary by type of customer and are less pure when repeated.
ESA 1995 places high demands on the homogeneity and quality adjustments when registering changes during different periods.

Quality evaluation of services

The difficult question of quality evaluation has recently come up in the international sphere. McKenzie (2002) and Ugai (2002) have pointed out the problem and the known methodology, but hardly show any more specific solutions, even if the last-mentioned reference gives some empirical results. Collins (2003) and Moriya (2003) have presented concrete examples of quality adjustments.

Current requirements for service price indices in Sweden

There is a basic work strategy that applies to both the development of indices for new service industries and the review of existing indices.

Four guiding principles are applied:

- The service price index is a **producer price index** that describes the average price development at the producer level for service industries, where services are delivered from domestic service producers. The index figure refers to a quarter period and the price data represent **an average** per quarter.
- Measured services should be **representative and stabile**.
- Measurements should refer to **transaction prices**. The transaction price is the true price for the good/service that the buyer pays and at which the seller sells, i.e. the price after deduction of all discounts.
- **PPS** (Sampling by Probability Proportional to Size) is the main sampling methodology.

Cooperation with industry organisations and companies is necessary since price changes should be observed and described. Initially, a special industry competence has to be developed. These special service industry competences require much time, but both cooperation and competence are extremely essential components of the work for each service industry where a price index should be developed.

How to secure measurement of same quality within the production of PPI for services

The rapid expansion of development of PPI for services in Sweden and the restriction of the production's budget in combination with the high requirements of National Accounts unit have led to the choice of the following arrangement of production:

A. New πPS sample every year
B. Updating of the weight structure every year

C. New questionnaires every year
D. Ongoing methodological review of industry indices every 3 – 4 years

A. New πPS sample every year
There are a number of different methods for probability sampling, all of which select a sample randomly and objectively. It is also possible to get a measurement of the sample's quality.

A probability sample has been used since many small enterprises account for a large share of the turnover. One advantage of a probability sample is that a small number of small enterprises represent a large number of small enterprises, and are thus significant. By only measuring large enterprises, a considerable amount of the turnover disappears. By making a subjective sample, the significance of small enterprises is very little and only influences the price index slightly.

A πps sample is used for all industries. Pareto πps is used since it has lower variance, at least asymptotic and according to simulation studies (Rosen, (1996)).

Within PPI for services in Sweden, the πps sampling method is used to draw a new sample every year. This is done during the month of November. Sampling frames are constructed so that the smallest enterprises in the industry are spared, as enterprises with low turnover or few employees are not included. The size limit is chosen subjectively, depending on what is appropriate for the specific industry. Thereafter πps sampling is used for all surveys with many enterprises within an industry. The probability that an enterprise may be selected in the sample is proportional to its size. For example, the measurement of size can be the number of employees or the turnover. An advantage with using this method is that the sample is "self-weighted", which means that it is not necessary to construct weights from ambiguous sources, as is often the case. Furthermore, there is a higher possibility that the larger enterprises, which can be seen as guiding the setting of prices within the industry, will be included in the sample. To ensure that the burden of respondents is not too large and that changes in the industry are not missed, new samples are drawn every year when 20 percent of enterprises also rotate out of the sample. (See Annex 3: General information on πps sampling)

B. Updating of the weight structure every year
The structures of service industries are generally more changeable than the structure of manufacturing industries. Enterprises within special computer services (NACE Rev 1.1 72) and Other business services (NACE Rev 1.1 74) are especially vulnerable to rapid changes. But the same can be said about enterprises in the transport industry (NACE Rev 1.1 60-63) and financial enterprises (NACE Rev 1.1 65-67)
Other industries have been greatly affected by deregulation of postal services and telecom markets (NACE Rev 1.1 64).

Therefore it is important to be aware of new information when it is available in the Business Register of Statistics Sweden, and look over the weight structure. Other sources besides Statistics Sweden are also used. Concerning the weight distribution between different services in each enterprise, questions are posed to the enterprises once a year.

From reference year 2003 on, data collection has been extended to cover all industries within the service sector. Data on turnover by product are included in the annual Structural Business Statistics questionnaire. This gives an opportunity to meet the demands from both the National Accounts and Service Price Indices. It is also a huge step in the direction of having an equal data collection for the service sector as for the manufacturing sector.

C. New questionnaires every year

Once a year the enterprises receive introductory information and questionnaires by mail. They can then choose different response alternatives and they are asked to select themselves at least four representative and recurring services (and specify them carefully) and then asked to set a price for the same service in the following quarters. It is important to regularly update the representative services. When one of the enterprise's representative services is no longer representative, it should be replaced with a more representative service.

The index figure refers to one quarter and, if the service has been carried out several times during the period, the price data should represent an average for the quarter.

D. Ongoing methodological review of industry indices every 3 – 4 years
The aim is to look over both the index construction and the industry as a whole periodically. When large changes occur in an industry, a new industry description is made. Since changes occur rapidly, a cycle of 3-4 years is a suitable interval for review. This means that, for example, a review of the industry for Renting services of automobiles (NACE Rev 1.1 71.1) as well as the index construction occurred last year, since the PPI for Car rental was developed in 2000. Next year it will be necessary to review the PPI for Computer and related services (NACE Rev 1.1 72), and in 2006 it is time to review Architectural, engineering and related technical consultancy services (NACE Rev 1.1 74.2), etc.

Conclusions

All above listed key procedures are helping to provide PPI for services as relevant as possible, to keep the size of all industries samples small and despite of that deliver good quality of the indices. The burden of respondents is kept low both due to the small size of samples and due to rotation (20 percent/year) among small companies.
Small size of samples is helping to keep the production costs relatively low despite the increased cost by new provided indices.

Cooperation with experts from other units within Statistic Sweden (National accounts, Services, Transports, International trade and others) will hopefully increase the consistence of economic statistics.

Good relationship with industry organisations legitimate the work with service statistics and create the source of early information about news within every industry. More time for that cooperation is listed as an important issue. The views from a range of users are always taking into account and create an important source of knowledge among statisticians working with price statistics.

International cooperation concerning methodological issues and exchange of experiences increase the comparability of statistics in the most natural way, save cost of development and increase transparency of used methods.

Dissemination of both results with methodological descriptions and development reports by Internet increases availability of PPI for services among both known and unknown users.

There are, of course, many issues that can be improved but it seems PPI for services in Sweden, as a part of the brand of official statistics, is on the right way to increase its credibility.

Annex 1 Methods and sources for price and volume measures in Swedish National Accounts

General procedures

The widespread international use of national accounts data has led to an extensive set of international definitions and guidelines. The SNA93 contains the worldwide applications, and the ESA95 is the EU version. Most of the harmonisation work done so far, however, has focused on current price data, such as the level of GDP, while the volume growth of GDP, which is one of the most used national accounts figures, has not been focused on to the same extent. However, an increased demand for more harmonised price and volume data has put focus on the methods used in different countries for volume calculations. Member States of the EU have therefore been asked to provide an inventory of their respective methods for constant price calculations within the respective countries´ System of National Accounts. Eurostat also published a handbook on these items in 2001.

With a focus on the measurement of the volume growth of GDP an intertemporal price and volume measurement has to be performed. Constant prices describe a fictitious situation of a certain year in the prices of another year. In reality the transactions of the current year could not take place in an identical manner at the prices of another year. The aim of these calculations is therefore to analyse which changes in aggregates are due to price movements and which are due to volume changes. A transaction's value in a current price can consequently be broken down into a price and a volume component. The price component should then only include the changes arising from real price changes. The volume component should take care of all other changes, e.g. quantity, quality and composition.

By following the principles on which the System of National Accounts is based, it is possible to obtain a direct measurement of GDP in constant prices from the output side or from the expenditure side. According to the output approach, GDP at market prices is equal to Output at basic prices minus intermediate consumption at purchasers' prices plus the sum of taxes/subsidies on products. Following the expenditure approach GDP can be obtained as Final consumption expenditure by households, by government, by NPISH plus gross fixed capital formation, changes in inventories, acquisitions minus disposals of valuables and exports minus imports.

The expenditure side is the main approach in the Swedish National Accounts

In order to provide an insight into how constant prices are presented in the System of National Accounts, a summary description is given here of the calculation procedure.

GDP as measured from the production side and use side is calculated, compiled and balanced in the product accounts section of the System of National Accounts. The annual calculation of the product accounts is balanced in a system of supply and use tables (SUTs). Balancing is carried out over 400 product groups for 134 industries. Services are classified according to 120 product groups, with goods accounting for the rest. The 140 purposes of household consumption according to COICOP are broken down further into 258 product groups. Consumption expenditure of departments and agencies of government is broken down partly by sector and partly by purpose according to COFOG. Investment breaks down into 55 product groups in around 75 industries and 10 purposes within the sectors of general government. SUTs are based on the principle that supply must balance with use for each product group. This means that Swedish output + imports (supply) must be equal to intermediate consumption + final consumption + investment + exports (use).

First of all, all output, imports, customs duties and exports, together with sales by departments and agencies of government and non-profit institutions (NPIs) at basic prices are entered into a database. All values are calculated at both current and constant, prior-year (t-1) prices. The degree of detail varies, and both industry output and foreign trade in goods are calculated at 8-digit CN level. The price indices used for conversion from current to constant prices are the producer, export and import price indices, as well as the unit value index. This is followed by aggregation to the product groups. Output of services is broken down directly into around 120 product groups.

Chain price indices are used

Annual chaining

In the production cycle for Sweden's annual national accounts, the first preliminary figures are based on the sum of four quarters. These figures are calculated in March t+1. In November t+1 the first annual calculation is published and in November t+2 final figures based on more comprehensive material are published.

In 1999 when the calculation methods for constant prices were changed, it was discussed whether the actual periods should be calculated with weights from t-2 (last final year) or whether the t-1 (preliminary annual calculation) with less “final” values were sufficient for the first preliminary data based on the sum of the four quarters. It was finally decided to use the latest year as base-year for chaining. Even if figures for t-2 could be expected to be more reliable, one had to admit that t-1 figures were the best estimate for the weights that should be used at the end. Another advantage is that one does not have to use indices with t-1 and t-2 in the same system. Having constant prices always in last year’s prices also turned out to be an advantage when having to change reference year for publication purposes.

In practice, values are stored in current prices (t prices) and in t-1 prices so that it is possible to add figures at detailed levels to aggregates. Three formulas are used for chaining. In the examples below, the reference year is 1995 = COP95.
(1)

For reference year 95COP95=95t

(2)

For later years 96cop95= 95COP95*96t-1/95t

97cop95= 96COP95*97t-1/96t

(3)

For earlier years 94COP95=95COP95*94t/95t-1

93COP95=94COP95*93t/94t-1

These formulas are used on transactions and aggregates with constant positive or negative signs. For items that change signs over time, other methods have to be used.
As changes in inventories cannot be calculated in a "normal" way, other alternatives had to be found. It was decided to present inventories in reference year prices with the same share of GDP as in t-1 prices.

For external balance of goods and services both exports and imports are presented in reference year prices and the net amount can be subtracted.

The item trading gains or losses is more difficult, so no value is presented in reference year prices at all. However, the effect of trading gains or losses is of course included in the chaining of GNI. Another item where reference year prices are not presented is the residual between GDP by the expenditure approach and by the production approach.

Quarterly chaining

Comparison of quarterly growth rates in Sweden has by tradition mostly been the annual link between a quarter and the equivalent quarter the year before. If these periods are to be compared, they need to be expressed at the same price-level. After calculation of the fourth quarter we recalculate t prices for the quarters from t-1 prices by using the current prices over the year divided by t-1 prices over the year.

95Q1t=95Q1t-1*Sum95QnCUP/SumQnt-1

The annual value in current prices and in t prices is the same and any discrepancies due to rounding are added to the fourth quarter.

This means that for every period a value is expressed at four price levels:
Current prices; t prices; t-1 prices and reference prices. The reference prices are then calculated the same way as the annual series and any discrepancies due to rounding between the annual figure and the sum of quarterly reference prices is added to the fourth quarter.

In the 3 examples below, the reference year is 1995 = COP95.

	(1)
For reference year	95Q1COP95=95Q1t
	(2)
For later years	96Q1cop95= 95Q1COP95*96Q1t-1/95Q1t
	97Q1cop95= 96Q1COP95*97Q1t-1/96Q1t
	(3)
For earlier years	94Q1COP95=95Q1COP95*94Q1t/95Q1t-1
	93Q1COP95=94Q1COP95*93Q1t/94Q1t-1

The same exceptions to this rule occur for quarterly reference prices as for annual prices. They are inventories, trading gains or loss, residuals and other net amounts.

General methods for implementation of new products and quality control

New products

Continuous discussions are held regarding the collection of price information for new products. The Price unit within Statistics Sweden receives new values from the national accounts on

household expenditure and values from household budget statistics every year as a basis for recalculating the weights in CPI. A forecast for household expenditure in the fourth quarter is made in December every year so that the weights for household expenditure in year t are based on the preliminary information on household expenditure values for the year t-1.
The Price unit also receive new information every year from the production of goods in manufacturing on a detailed level of classification and from international trade statistics on CN-numbers. The Price unit checks the values reported at the detailed level. If the value for a group has risen or fallen, checks are made in order to find out why. Maybe a new product has been included within the group, and then the contents of the group are analysed and the new product added. Regarding PPI, however, the weights are based on t-2 figures, as the detailed information is not available earlier.

The following general methods are used in order to take quality changes into account

No adjustment = pure price effect
Automatic chaining = pure quality difference
Option prices, e.g. you know what has been changed and also the market prices for these changes
Production costs, does not take the user's valuation into account
Expert valuation
Hedonic models
Overlap
New sample, aggregated overlap, especially MCR, Multiple chaining and re-sampling
Imputation from a higher level to a lower level

Annex 2 Ideal quality considerations in a producer index

Micro-economic theory includes the basic differences between input-output price index (i.e. price index with user perspective and producer perspective; compare e.g. Allen, 1975). Statistics Sweden's Scientific Council recommended that these differences in quality adjustments should be brought to attention in the continuing development work.

This question has been further developed by Triplett (1983) who presents it briefly as follows: In both the input and output perspective, a product can be understood as a package of characteristics of the product. A quality change of the product can be regarded as a change in the composition of the different characteristics of the product. This kind of change can in turn be regarded in the same way as a change in the composition of different products of the index basket. In this way, quality changes are conceptually handled by the index theory (as according to Allen, in the place cited).

According to Triplett, the difference between input and output perspective is that the characteristics have different implications. An input-characteristic is a product property that is to a certain advantage for the consumer (the buyer of the product). On the other hand, an output characteristic is a product property where certain resources are required to obtain when the product is produced.

This means that for an input-index, quality evaluations are made based on the change in advantages of the consumer by the change of product properties. However, quality evaluations of an output-index are based on the change in production costs by the change in product properties. Quality adjustments are made in such a way that "technology is held constant", i.e. when calculating the index, the effects of such changes are eliminated in the conditions that are due to technical development.

Triplett also points out that the difference between the input and output index should not be exaggerated, since that which is produced is in demand as a rule, but exceptions like fundamental distinctions exist.

Annex 3 General information about πps sample

Sampling in general

Assume there is a population with observation values (y_1, y_2, …, y_N), where N is the population size. An element in the population, an individual, is applied to estimate a total $\theta = y_1 + y_2 + \ldots + y_N$, using a sample with sample size n. There is a size measure (s_1, s_2, …, s_N) for all individuals, where s can be the number of employees or the net turnover of the enterprise.

The sample inclusion probabilities for individuals are π_1, π_2, …, π_N. This means that enumeration factor for an individual is $1/\pi_i$, which means that the chosen individual represents $1/\pi_i$ individuals, itself and $1/\pi_i - 1$ others.

To estimate θ, the Horvitz-Thompson (HT) estimator can be used
$\hat{\theta}_{HT} = \sum sample(y_i / \pi_i)$.

πps sampling in general

Given a size measure (s_1, s_2, …, s_N) for all individuals, the sample design is said to be of πps design if the sample inclusion probabilities, π_k, are proportional to s_k; $\pi_k \propto s_k$.

Given the sample size, n, the sample inclusion probabilities are defined as follows

$$\lambda_k = \frac{ns_k}{\sum_{j=1}^{N} s_j}, k = 1,2,\ldots,N.$$

To make an order πps sample, then $\lambda_k < 1$ for all k. Those individuals for which $\lambda_k \geq 1$ are excluded and put into a "take all" stratum[2]. Assume hereafter that $\lambda_k < 1$ for all k.

An order πps design[3] involves the following stages:
Stage 1: Establish the sample size and calculate λ_k for k = 1,2,…,N.
Stage 2: Create independent random variables U_k for k = 1,2,…,N with uniform distributions at the interval [0,1]. Ranking variables, Q_k are computed as follows;

$$Q_k = \frac{F(U_k)}{F(\lambda_k)}, k = 1,2,\ldots,N.$$

Step 3: Rank the frame with the ranking variable in ascending order. The sample consists of the units with the n smallest Q values.

If the function F is F(x)=x, which means that

$$Q_k = \frac{U_k}{\lambda_k}, k = 1,2,\ldots,N;$$

the sample is called a Uniform order sample πps, see Rosén (2001) or Sequential Poisson Sampling, Ohlsson (1990).

If function F is F(x)= x/(1-x), we have a Pareto πps sample. The variance for a Pareto πps sample is lower than that for a Uniform order πps sample and also for all possibilities of function F, see Rosén (1996) and Rosén (2000).

[2] In practice, the enterprises where $\lambda_k > c$, are included where $c < 1$.
[3] Note that this sample design is only an approximate πps sample.

Application for price measurement

When a πps sample is used for price measurement, two estimates can be done. Either

$$\theta = I_{01} = \frac{\sum_i q_{i0} p_{i1}}{\sum_i q_{i0} p_{i0}}$$

or,

$$\theta = I_{01} = \sum_i w_i \frac{p_{i1}}{p_{i0}} = \sum_i w_i I_{i,01}, \text{ where } w_i = \frac{q_{i0} p_{i1}}{\sum_i q_{i0} p_{i0}}, i = 1,2,...N.$$

Here p is for price, q for quantity and *i*, individual, is for enterprise.

There are then two options for parameter estimation. In the first case, parameters are estimated as a ratio of the two estimates. In the second case, the parameter is estimated as a total.

Which is chosen depends on the way that the size measurement is to be interpreted. Is it a volume or a value?

If the size measurement is to be interpreted as a value, $w_k = \lambda_k/n$ for k = 1,2,…,N. In this case, $y_k = w_k I_{i,01}$. Here, it is a total estimation, HT estimator,

$$\hat{\theta}_S = \sum_{sample} \frac{y_i}{\pi_i} = \sum_{sample} \frac{w_i I_{i,01}}{\lambda_i} = \frac{1}{n} \sum_{sample} I_{i,01}.$$

indexed with S (sum) to differentiate it from the next case.

Practical consequences for price measurements

We assume that individuals respond independently of each other with the same response probability. If non-response occurs, the following non-response model can be used: When estimating θ_s, n can be exchanged for n´ which is the number of respondents. For θ_{kv}, no modifications are necessary.

A commonly occurring problem is overcoverage, enterprises which are included in the frame that cease production in that industry. This means that the sample becomes smaller as individuals are deleted. In addition, the sample probability is altered. One way to establish the sample size, n, is the following. Let n´´ > n.

1. Rank the frame according to the rank variable.
2. Take out the n´´ number first in the frame
3. Go down the list in rank order until n observations have been obtained.

Here the sample probabilities are altered, but they are still proportional to s. This means that the estimate does not change. However, it is necessary to check that the sample probabilities are still less than 1 for those individuals that are not included in the "take all" stratum.
This can be avoided if n´´ is not too large and if the "take all" stratum contains individuals where $\lambda_k > p$, where $p<1$. The figure p is called the Pareto limit.

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