

Quality adjustments and capital goods

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Abstract

In 1997 Statistics Norway took the initiative to a project aimed at improving the methods for calculating price indices of capital goods (durables) for national accounts purposes. Part 1 of the project was a descriptive study of methods used to handle quality changes for capital goods in the EU/EFTA member states, and some overseas OECD countries (USA, Canada, Australia and New Zealand). Information was collected on the methodology used to compile the Producer Price Index (PPI), Consumer Price Index (CPI) and External Trade Price Indices.

Part 2 will probably take place in 1999 and 2000, and will be a normative study building on the results and discussions from part 1 of the project. Part 2 will be concluded by a final report to be published in year 2000¹.

The general impression is that more resources are allocated to produce the CPI than the PPI, while least resources are allocated to the production of external trade indices. This priority on the CPI may reflect the higher interest in society at large for this index, compared to other indices. For external trade indices most countries are using the relatively simple unit value method where data already are collected to produce external trade statistics. Chaining combined with resampling is more common for the CPI than for the PPI and external trade price indices. For the PPI the most common period of resampling and reweighting is every 5th year. For the CPI the most common methods to handle quality changes are overlap pricing and judgmental adjustment. Cars and personal computers are the commodities for which explicit methods are most used. For the PPI the most common method is also overlap pricing. A few countries are using hedonic methods for handling quality and the method is mostly used in calculating sub-indices in the CPI.

¹ The project is cofinanced between EUROSTAT and Statistics Norway. This paper presented for the Ottawa Group is based on a preliminary and unpublished report from the project group.

1. General background

A major problem in measuring price trends for capital goods is the complexity of the goods. «Capital goods» is a product group that is affected by a fast pace of innovation, which means that it can be difficult to find “similar” goods over time. Moreover, the goods will frequently be specially designed to the user’s needs and specifications. This may apply to both technical specifications and more exterior-type requirements. Furthermore, capital goods often have services attached that affect the price. New goods, new models of old goods, new technologies, higher performance of existing goods and new services associated with goods will appear continuously in a dynamic economy. Traditional methods of calculating price indices are designed for a static economy where a constant “basket of products” can be compared over a longer time period.

The work with data collection and the methods for measuring the price of capital goods is therefore faced with a number of problems. These problems may be summarised by the following:

- quality changes over time for the same product
- uniqueness, for example in the form of special design
- difficulty of distinguishing goods from the associated service
- different sales conditions with possible price differentiation

The aim of a price index is to measure a "pure" price change. Any changes in the quality of the goods and services must therefore be taken into account in index compilation. The potential bias caused by quality changes is considered to be a serious problem in index calculation, and the problem is especially relevant for capital goods due to the fast technological development these goods are subject to.

2. Quality change

Quality improvement can be defined as an improvement on the capability of the capital good to create net income for its owners on the production side. On the consumption side, quality improvement is an improvement on the capability to create net utility for its users, see Gordon (1990). Most international studies have concentrated on price measurements for capital goods in restricted markets. PC equipment has been an often-studied category in such works. This study has a wider perspective, considering the fact that the weakness of price measurements is a broad-based problem that is equally relevant to deliveries to different markets, to exports and not the least to imports of capital goods.

2.1. Handling of quality changes

The handling of quality changes and new products can be separated into four general categories of potential errors, see Moulton and Moses (1997):

- failure to detect a change in quality
- failure to make the appropriate adjustment for a change that has been detected
- failure to include new products in the sample without long time lags
- failure to include the net revenue/ consumer surplus generated by new products

In general, Moulton says, the new product bias is known to be an upward bias in contrast to the quality bias. Which in principle can go in either direction. The goal of producing price indices like CPI, PPI and external trade price indices is to measure *pure price changes* and exclude changes due to improvements or deterioration in the quality of the goods. In a price index the appearance of new goods presents at least two important problems; bringing new goods into the samples and accounting for differences in price between new and old goods. Sometimes new goods provide a similar service as an existing one, but with higher quality. In other cases new goods provide entirely new services that were previously unavailable, such as cellular phones.

2.1.1. Special problems with unit values

The calculations of indices for external trade are associated with the decomposition of the series of value into price and volume changes. This implies that one has to decide for which component to choose formula. Because the price relatives are used as deflators for national accounts this is already determined. Volume indices are calculated according to Laspeyres formula, and price indices are calculated according to Paasches formula.

The main objection to the use of the unit value approach has been that even the most detailed commodity specification in foreign trade statistics is not detailed enough for the price data required for the decomposition of the flow values. The unit value approach may in this case fail to give a satisfactory price in the sense of being liable to unit value bias.

Several commodity classification categories and particularly those related to capital equipment, machine tools and several varieties of consumer goods have often no meaningful unit of quantity. These commodities are often unique in the sense that they are goods, which due to their characteristics cannot be matched over time with similar goods.

Unique goods exist only at one particular time, and that defeats all attempts to see them in terms of a flow. This of course makes it impossible to do any kind of decomposition. The solution to the problem will be to use substitute prices, and that is undoubtedly implicit done in many cases by classifying these goods under a common designation in the Customs Tariff.

3. The survey

Part 1 of the project was a descriptive study of methods used to handle quality changes for capital goods in the EU/EFTA member states, and some overseas OECD countries (USA, Canada, Australia and New Zealand). First, countries were asked to send documentation of their methodologies for index production. Then a questionnaire was designed for systematically collecting information on how indices were produced in these countries and specifically how quality changes were handled in the production of these indices for capital goods. These questionnaires were divided in two parts. One part were general data on index production was collected - see Annex 1, and a second part asking for methods used to handle quality changes for some selected capital goods, see Annex 2.

3.1. Results and conclusions

The questions on general methodology cover the following areas:

- Sample design
- Weighting, computation and classification
- Data collection

3.1.1. General impression

The general impression is that more resources are allocated to produce the CPI than the PPI, while least resources are allocated to the production of external trade indices. This priority on the CPI may reflect the higher interest in society at large for this index, compared to other indices. The countries investing most resources on sophisticated methods for the PPI seems to be France, the Netherlands, Sweden, Finland and the United States.

For external trade indices most countries are using the relatively simple unit value method where data already are collected to produce external trade statistics. Even those countries that are spending resources on collecting prices directly from importers and exporters are using the most simple methods in doing so. They are for example relying on self-administrative questionnaires rather than visiting interviewers.

3.1.2. Resample and reweighting

The answers on general methodology shows that chaining combined with resampling is more common for the CPI than for the PPI and external trade price indices. In the French, Italian, Swedish and Norwegian CPI both reporting units and representative items are resampled annually, as well as annual reweighting. In the French CPI 10 per cent of representative items are resampled every year, and in the Swedish CPI 20 per cent of reporting units are resampled every year. The same countries that are following an annual sampling of reporting units and representative items in the CPI as well as annual reweighting are also using annual chaining. In United Kingdom representative items are also reweighted annually in the CPI. In Luxembourg there is a continuous adaptation of the sample and annual reweighting. By having an annual routine in selecting goods and services new products are more rapidly incorporated into the index. Some countries have answered that they are resampling continuously as old units or items disappear, but not specifically mentioning product improvement. The United States is planning more frequent resampling in the future for items in markets undergoing rapid change, like capital goods.

For the PPI the most common period of resampling and reweighting is every 5th year. However, Sweden and Finland are resampling reporting units and representative commodities as well as reweighting annually. The United Kingdom is planning annual resampling from 1999/2000.

3.1.3. Data collection

Comparing the answers on the methodology for collecting data one observation is that the use of face-to-face interviewing by experts from the National Statistical Institute is more common in collecting data for the CPI than for the PPI. For the price indices for external trade no country is using interviewers. Instead of interviewers, self-administrated questionnaires are used. This was supposed to be reflected in the answers in questionnaire “B”, where we specifically asked how quality changes are handled, since the more explicit methods to handle quality changes in the CPI usually require visits to the companies by specialists from National Statistical Institutes.

For the CPI, only Norway and Switzerland answered that they were not using face-to-face interviewing except when introducing the survey to reporting units. For the PPI only France, Greece and the United States answered that interviewers were used, while all the other countries were using self-administrated questionnaires sent to the companies to be filled in by the employees of the companies. For external trade indices, all countries that are collecting prices are using self-administrated questionnaire.

3.1.4. Handling quality changes

In questionnaire “B” we asked how quality changes for selected capital goods were handled. The overall impression from the answers is the great variation in used methods. To complicate the picture furthermore most countries also used several methods for each commodity. The different methods used to handle quality changes for the same commodity in the same index was widely different, from the simplest to the most sophisticated method. However, it seems that quality changes are always taken serious into account in calculating both the CPI and the PPI.

For the answers of questionnaires “B”, we have grouped the methods together in four main categories.

- A - implicit methods. This category covers unadjusted price comparison, link to show no change, price overlap and imputation.
- B - explicit methods. This category covers option cost adjustment, production cost adjustment and hedonic adjustment.
- C - not specified. This covers the method called judgmental adjustment and those who have answered “other method”.

- D - no calculation. This may be either because there is no production, import or export of the commodity, or because the statistical institute regard the commodity as so complicated that they have excluded the commodity from the index all together, such as ships and aeroplanes.

For the CPI the most common methods to handle quality changes are overlap pricing and judgmental adjustment. Of the explicit methods, option cost adjustment is most commonly used in the CPI, while production cost adjustment is most commonly used in the PPI. One particularly difficult product is machines for special purposes. For this product overlap pricing and judgmental adjustment are the most common methods.

The commodities for which explicit methods are most used are cars and personal computers. For the PPI the most common method is also overlap pricing. For the PPI there are fewer answers because commodities like PCs, cars and aeroplanes are only produced in a few countries.

A few countries are using hedonic methods in calculating indices. It is mostly in calculating the CPI the hedonic regression method is used. The United States, France and Finland are using hedonic regression to calculate CPI for some specified products. Of capital goods, the method is used personal computers and televisions in the United States, and there are plans for hedonic indices for these commodities as well in France. In France hedonic regression is only used for dishwashers at the moment. Finland is using this technique for used cars. The method is also used in some of the responding countries for other commodities falling outside our focus on capital goods (clothes, housing). In the PPI hedonic regression is only used to adjust for quality changes for computers and only France, Sweden and the United States are using this method. The United States is using this method also for other computer equipment (like printers).

Other sophisticated methods are using experts or studying professional magazines to determine the price development. Sweden is using an expert panel, which meets once a year to produce a list of the details a car can have, and thereby determine quality changes in the CPI for new car models. One of the most important quality characteristics is petrol consumption. The Netherlands is studying computer magazines to determine the quality adjusted price development for computers and use expert's views to handle quality changes in the CPI for cars.

For external trade, 11 of the 15 responding countries are using unit value indices. For this method, quality adjustment is difficult. For the countries that are collecting prices directly and therefore have the possibility to adjust for quality changes, judgmental adjustment and overlap pricing are the most common methods. One conclusion is however, that if they are adjusting for quality changes at all, most countries are using implicit methods. The only country that is using only explicit methods for all commodities where they are calculating external trade indices is the United States. The United States is using hedonic regression to adjust for quality improvements of computers. Germany and the United Kingdom are also using an explicit method (production cost adjustment) for external trade indices, together with other methods, but none of these countries are using hedonic regression to calculate indices for external trade.

Among the selected capital goods were ships and aeroplanes. One main discovery was that very few countries are including these two very complex capital goods in their PPI. Finland and the United Kingdom are the only countries in this survey that have a producer price index for ships. For Finland the producer price index and export price index for ships are input cost indices, and not an output price index as for other goods in the PPI and export price index. The price development is calculated for 12 important cost factors involving both prices of manufactured items and wage and social costs. Listed prices from the Lloyds Shipping Economist are used for the import price index.

3.2. Second part

Based on the results of the descriptive study, part 2 of the project will be a normative study, where different methods on handling problems raised in the project will be discussed and recommendations will be made. In our discussion on the relevant methods, we will follow the method outlined in Eurostat (1998) Draft Commission Decision) on prices and volumes, and divide the methods in three

classes, “A”, “B” and “C”-method. The Draft Commission Decision on prices and volumes defines the “A”, “B” and “C”-methods as follows:

- A methods: most appropriate methods;
- B methods: those methods which can be used in case an A method cannot be applied;
- C methods: those methods that shall not be used.

The Draft Commission Decision further states: “The following criteria for distinguishing A, B and C methods are absolute criteria, i.e. they do not depend on the availability of data. In practise it might be that the A methods are not attainable, and conventions need to be sought on B methods.” This makes clear that the classification of methods into A, B and C methods should be based on objective standards; it should be a classification which the good methods are, the less good and the bad ones, regardless of the feasibility of the methods.

The normative part of the study will be divided into first an objective classification of relevant methods, based on the classification method described above. Then there will be a feasibility analysis of the relevant methods for each category of goods. The classification of methods and the feasibility discussion will be treated separately. The classification of methods can however differ from product to product: what is a good method for one product can be a less good method for another. For example, the importance of taking quality changes into account will differ. In some cases, the lack of allowances of quality changes can be prohibitive for calling a method a B method. Such is the case if the product is characterised by a fast technological development. In other cases, even without allowance for quality changes a method could be called an A method if such quality changes can be considered to be negligible.

References

Gordon, Robert J. 1990. "The Measurement of Durable Goods Prices". University of Chicago Press. Chicago.

Moulton, Brent R. and Karin E. Moses. 1997. "Addressing the Quality Change Issue in the Consumer Price Index". Brookings Papers on Economic Activity, 1:1997

Annex 1



Statistisk sentralbyrå
Statistics Norway

A1

The Consumer Price Index

Survey of Methodology Used in European and North-American Statistical Institutes

This part of the survey is expected to give general information on how to calculate the Consumer Price Index, and not only for capital goods. In the questionnaire, we use the phrase “reporting unit” to refer to the unit responsible for the supply of all queried information.

Please take time to fill in the questionnaire. If nothing else is stated, tick only one box for each question.

Country:

Name of institution:

Name of responding person(s):

E-mail address of responding person(s), if available:

Data Collection in the Consumer Price Index

1. Is it statutory or voluntary for the reporting unit to take part in your consumer price index?

- Statutory
 Voluntary

2. How do you collect data for your consumer price index?

If you use a combination of methods, please tick a box for each of the methods you use.

- Self-administered questionnaire —> go to question 3
 Face-to-face-interviewing using paper questionnaire —> go to question 3
 Face-to-face interviewing, computer aided —> go to question 4
 Telephone interview —> go to question 4

3. Do you preprint your questionnaire with figures from previous periods?

- Yes, always
 Yes, in certain cases. Please describe:

No

4. Do representatives from your statistical office visit the reporting units regularly for other purposes than collecting price information?

- Yes —> go to question 5
 No —> go to question 6

5. What is (are) the purpose(s) for the visits, and how often do they visit the units?

Please describe:

Sample Design in the Consumer Price Index

6. How many reporting units contribute to your survey?

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7. How often do you resample reporting units?

- Yearly
- Every fifth year
- Every tenth year
- At other intervals, please describe:

Description: _____

8. What sample design is your survey based on when you resample reporting units?

- Judgemental —> please describe
- Purposive —> please describe

Description: _____

9. How many elementary aggregates are covered by your survey?

By elementary aggregates we mean the first level of aggregation.

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10. How often do you resample goods and services (representative items)?

- Yearly
- Every fifth year
- Every tenth year
- At other intervals, please describe:

11. What sample design is your survey based on when you resample goods and services?

- Judgemental —> please describe
- Purposive —> please describe

Description: _____

Weighting and Computation of the Consumer Price Index

12. How often do you reweight (using National Accounts or Household Budget Surveys)?

- Yearly
- Every fifth year
- Every tenth year
- At other intervals, please describe:

13. How many price equations do you enter into the computation of the index?

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14. Which index formula do you use when computing the Consumer Price Index?

- Laspeyre
- Other, please describe:

15. Do you use periodical chaining?

- Yes, yearly chaining
- Yes, other periodical chaining. Please describe:

- No

16. How do you compute your microindex?

If you use a combination of methods, please tick a box for each of the methods you use.

- Ratio of average prices
- Average of price ratios
- Geometric mean
- Other, please describe:

17. Do you use Hedonic regression in the Consumer Price Index?

- Yes ———> go to question 18
- No

18. For which commodities or commodity groups do you use Hedonic regression?

Description: _____

Thank you for filling out the questionnaire and giving us valuable information!

Annex 2



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B1

Calculation of Indices for Capital Goods The Consumer Price Index - Adjusting for Quality Changes

Survey of Methodology Used in European and North-American Statistical Institutes

In this questionnaire, we ask how you handle quality changes of capital goods in your consumer price index.

How to answer this questionnaire

On the next page, we have listed various methods used for handling such changes. On the following pages, we ask which method you use for certain types of capital goods. Several ticks are possible. If you use a **combination** of different methods for different products within a group for this index, tick the relevant boxes and give a further explanation below. If you use **other** methods than the methods listed, tick the box “other method” and give a further explanation below. If the commodity is **not relevant**, tick the last box.

Country:

Name of institution:

Name of responding person(s):

E-mail adress of responding person(s), if available:

A list of currently used methods for accounting for quality changes

A. Methods which involve replacements without explicit (or direct) quality adjustment

1. **Unadjusted price comparison.** The estimated price change is the price of the new item in the comparison period divided by the price of the old item in the reference period.
2. **Link to show no change.** The estimated price change for the observation series is set to zero between the comparison period and the preceding period without use of an overlap method.
3. **Price overlap.** In at least one period prices for both an old and a new item are collected. Price change up to that period is estimated from the old item and after that period from the new item. An N-period overlap means that there are N consecutive periods of parallel pricing of both the old and the new item. The N-1 periods price change may then be based on either the old or the new item or of an average of the two.
4. **Imputation.** An average price change is imputed from a higher aggregate to which the observation series belongs.

B. Methods which involve replacements combined with explicit quality adjustment.

5. **Option cost adjustment.** This method values an extra characteristic, now included in the price of a composite product, at its actual price as an optional extra in the previous period or as a certain portion of that price.
6. **Production cost adjustment.** The producer is asked how much an extra characteristic costs to produce. This measure of cost is marked up to the retail level (in the case of a CPI) and used for adjusting the reference price.
7. **Hedonic adjustment.** The value of a characteristic is given by estimated coefficients in a multiple regression equation. Differences in the content of characteristics between the new and the old observation are multiplied by these values to provide a total adjustment to either the reference or the comparison price.
8. **Judgmental adjustment.** A quantitative judgement is made by experts, commodity specialists or price collectors such that a value is obtained for the quality difference between the old and the new observation.

1. Which method do you use for handling quality change when you calculate the consumer price index for personal computers?

- Unadjusted price comparison
- Link to show no change
- Price overlap
- Imputation

- Option cost adjustment
- Production cost adjustment
- Hedonic adjustment
- Judgmental adjustment

- Other method, please give a further explanation below
- Not relevant, since the commodity is excluded from the index

Further explanation:

2. Which method do you use for handling quality change when you calculate the consumer price index for televisions?

- Unadjusted price comparison
- Link to show no change
- Price overlap
- Imputation

- Option cost adjustment
- Production cost adjustment
- Hedonic adjustment
- Judgmental adjustment

- Other method, please give a further explanation below
- Not relevant, since the commodity is excluded from the index

Further explanation:

3. Which method do you use for handling quality change when you calculate the consumer price index for electric household stoves?

- Unadjusted price comparison
- Link to show no change
- Price overlap
- Imputation

- Option cost adjustment
- Production cost adjustment
- Hedonic adjustment
- Judgmental adjustment

- Other method, please give a further explanation below
- Not relevant, since these commodity is excluded from the index

Further explanation:

4. Which method do you use for handling quality change when you calculate the consumer price index for passenger cars?

- Unadjusted price comparison
- Link to show no change
- Price overlap
- Imputation

- Option cost adjustment
- Production cost adjustment
- Hedonic adjustment
- Judgmental adjustment

- Other method, please give a further explanation below
- Not relevant, since the commodity is excluded from the index

Further explanation:

5. Which method do you use for handling quality change when you calculate the consumer price index for boats?

By boats we think of yachts, other vessels for pleasure or sport, rowing boats and canoes.

- Unadjusted price comparison
- Link to show no change
- Price overlap
- Imputation

- Option cost adjustment
- Production cost adjustment
- Hedonic adjustment
- Judgmental adjustment

- Other method, please give a further explanation below
- Not relevant, since the commodity is excluded from the index
- Not relevant, since there is no domestic consumption of these commodities

Further explanation:
