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Replacements, quality adjustments and sales prices

Abstract

The first version of this paper was a report commissioned by Statistics Sweden for proposing alternatives to its most used quality adjustment method: direct valuation by the price collectors. We have revised it slightly, updated the tables and added a summarizing section for discussion in an international audience.

An analytical tool used was to follow product offer lives. By this we refer to the series of monthly observations of a certain product variant/model in a certain outlet which is included in the CPI. It turned out that many such lives start with a high price which is later reduced until the product offer is replaced by a new product offer starting again with a high price. Quality adjustments are then done when the price returns to its "ordinary level".

It is found that in these situations price collector valuation tends to assign part of the price increase at replacements to quality improvement even though it is hard to imagine that the product group as a whole could have experienced significant quality improvement. Neither is any form of overlap, including the bridged overlap, able to handle this situation unless one is willing to assume that the replacement model has a quality advantage that is consistent with its higher price.

The paper argues that in practical work the choice is between applying direct price comparisons for comparable replacements or an overlap methodology based on the mcr (monthly chaining and re-sampling) method. The former approach is best applied to "traditional" product groups with slow quality change and the latter to fast-moving products such as in home electronics.

So although neither of these approaches is fully defensible on theoretical grounds, we argue that in practice they will often be the best choice for products where replacements from low sales prices to high regular prices are frequent. Explicit adjustments based on hedonics, option prices or other methods should of course be used where possible but they cannot be expected to manage the bulk of replacement situations encountered in practical CPI work.

Background

The project

In 2012 Statistics Sweden (SCB below) carried out a number of studies on quality adjustment in the Swedish CPI. The study reported here was designed to assess and propose alternatives to the main approach so far

used in the field by SCB price collectors. In this approach the price collectors are evaluating the quality difference at replacements and field work a project to improve quality adjustment (QA) methods for all products that are collected by SCB's interviewers.

This report is a slightly revised version of a paper presented for the Swedish CPI Board in October 2012.

For the great majority of products discussed here the current Swedish QA method is judgemental assessment by the interviewer (price collector). In each case of replacement the interviewer gives her monetary evaluation of the value of the quality difference between the previous and the new product variety. We refer to this method as the ***interviewer judgement*** method. Some central supervision of the interviewer judgements is done and occasionally these judgements are changed but mainly not.

For two of the products – computers and mobile phones – the current method is a variant of the mcr method (monthly chaining and re-sampling, more below).

Thus the primary task of the project was to evaluate the interviewer judgement method and propose alternatives to it. Also, changes/modifications to the mcr method for computers and mobile phones was to be considered.

Previous research on Swedish data

Norberg and Suviranta [2] gave a comprehensive overview of QA practices in the Swedish CPI and made some comparative comments to practices in the Finnish CPI.

Ribe [3] compared a number of different quality adjustment methods to Swedish CPI data for the years 1997-2002. The scope of the study was more or less the same products that are under investigation in the present report. More specifically he compared the interviewer adjustment method to (i) direct price comparison, (ii) bridged overlap using regular prices, (iii) class mean imputation from regular prices, with price changes taken from comparable replacements only and (iv) link to show no price change. He came to the conclusion that the impact of QA by price collector judgment often turns out to be strikingly similar compared to that of e.g. bridged overlap and that the results seemed mostly plausible, except for clothing. J Dalén gave a comment to Ribes report (published jointly with it) in which he challenged Ribes conclusions and pointed to the positive implicit quality indexes for footwear, textiles and other groups as problematic since they lead to a lowering of the corresponding subindexes by several percentage points.

International recommendations

General international handbooks are usually very descriptive in nature and provide very few specific recommendations.

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HICP regulations to some extent provide a framework for especially issues regarding replacements and representativity. Exhibit 1 is taken from Commission Regulation (EC) No 1334/2007 regarding the HICP. The regulations draws delimits the quality change issue to be within a consumption segment only. Below, when discussing representativity and comparability, an interpretation of these paragraphs will be discussed.

Exhibit 1: From Commission Regulation (EC) No 1334/2007

(4) The HICP relates to the prices of all the products purchased by consumers, when they seek to maintain consumption patterns, i.e. products defined by elementary expenditure categories (weights). These categories consist of explicitly stated consumption segments distinguishable by consumption purpose. The set of all product-offers in the statistical universe can be exhaustively divided into consumption segments. Consumption segments are relatively stable over time although the product-offers comprising a consumption segment will change as markets evolve.

(5) The notion of consumption segments by purpose is therefore central to sampling and to the meaning of quality change and quality adjustment. However, an ambiguity in this concept concerns the level of aggregation at which it is defined and applied.

(6) The range of product-offers will change over time as products are modified or replaced by retailers and manufacturers. The HICP requires the representation of all currently available product-offers within the consumption segments by purpose selected in the reference period in order to measure their impact on inflation. This applies particularly to new models or varieties of previously existing products.

(7) Quality change thus relates to the degree to which available products are fit to serve the purpose of the consumption segment to which they belong. Quality change should be assessed by reference to the specification of concrete products within a consumption segment.

CENEX. For the purpose of the HICP a Handbook on QA methods [4] was produced in 2009 by a consortium CENEX (Centre of Excellence) from National Statistical Institutes (including SCB) on a Eurostat Grant. The Handbook treats seven different product areas in detail: (i) TVs, (ii) new cars, (iii) used cars, (iv) computers, (v) washing machines, (vi) books and (vii) software. This handbook has been presented to Eurostat in accordance with the Grant contract and no official decision has yet been made from it.

The general discussion and classification of methods is still of interest. Of the seven product groups discussed TVs and computers are of direct relevance to this project. Both for TVs and for computers hedonic methods are presented in detail and are considered to be A methods (best). Regarding TVs recommendations for a traditional method is also presented where a stratification is proposed based on type (LCD, plasma, tube), screen size and brand cluster so that replacements are always within the same stratum. A distinction between minor and major changes is made and direct price comparisons is recommended for minor changes and a bridged overlap or re-sampling for major changes. For computers two segments are identified, desktops and laptops (today surf pads may be a third segment) and bridged overlaps for laptops and option prices are proposed.

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Currently used QA methods

For products under consideration in this project

The main method applied at present for the products concerned in this study is interviewer judgement. Historically, the motivation of this method was that the interviewer could serve as a representative consumer, which would lead to their judgement being on average the right ones for the consumer collective as a whole. However, the variety in and complications of today's consumer markets put this philosophy in question. An interviewer is in her daily life not involved in purchases of most of the products in the CPI. From only the appearance and information of a product in an outlet it is often impossible to get a good idea of its quality. For more expensive products with frequent model changes most consumers spend some time to compare different product varieties, for example by looking up information in the internet, talk to shop attendants, friends etc. This is not typically possible for an interviewer in the moment of price collection. Therefore SCB interviewers have often expressed their frustration over the task of giving a monetary value for the quality difference between two products.

Interviewer judgements are reviewed by central staff. One person reviews all judgements quickly and selects some 5-10% of them for closer inspection. A judgement is considered suspicious for example if (i) a new, considerably more expensive product is judged to be of equal quality, (ii) if price and quality moves in different directions or (iii) if price differences themselves are large. For the selected cases he spends some 30 minutes on average on finding more information, usually in the internet and making a more informed judgement. For some 50 % of the selected cases (i.e. 3-5 % of all judgements) the central staff person actually changes the adjustment to something else. The central staff person is, however, not convinced that he is able to make good judgements in most cases. Only exceptionally is he able to apply a supported QA method and it is often not clear to him, which characteristics are really the important ones.

For **computers and mobile phones** a variant of the so called *monthly chaining and re-sampling* method is used (mcr, see below). Replacements are made according to the most sold criterion and computation is done by monthly links in which only identical models are included. The method works as an "implicit" form of quality adjustment, as described below.

For other CPI products

Cars and other transport equipment

New car models are re-sampled every December. No quality adjustment between old and new model types is done. But within a primary model, quality adjustments are done when a certain characteristic changes. The option price method is used when an additional feature becomes included in the price. 50 % of the observed or estimated market price for the

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feature, when bought separately for similar models without it, is then regarded as the value of the quality change. Another adjustment that is frequently made is the fuel efficiency adjustment, where the change in calculated fuel cost over a few years ahead is used for the quality adjustment.

For other transport equipment (motor cycles, caravans, campervans, boats) central staff makes the quality adjustments in a similar way as for new cars. The option price method is often used. But often no relevant information is available for applying this method and then often 50 % of the whole price difference is considered to be due to quality. It is not clear that these judgements always rest on solid ground. (These products are not in scope for the present study.)

Food and beverages

For food and beverages no quality adjustment is done. Prices are compared between identical products only. Quantity adjustments are done when package size differences are less than 50 % but else when a base period product can no longer be found in the outlet it is deleted and price change is in effect computed over the remaining product offers. We call this the **deletion** method.

The same method is in effect used for alcoholic beverages for which the calculation is done by Systembolaget (the Government monopoly). Computation is done over identical products and there are no replacements.

Quality adjustment - basic principles and rules of thumb

Representativity and comparability

Quality adjustment issues are closely related to methods for sampling and selection of products and to methods for replacements. Two important criteria for the evaluating such methods are representativity and comparability.

Representativity means that the sample of products and outlets should reflect the universe. *Comparability* means that when basic price changes are computed they should be between identical or equivalent product offers. It is immediately realised that these two goals are conflicting since the universe is dynamic with new products and outlets entering and old ones disappearing continually. How should this conflict be resolved?

The Commission regulation 1334/2007 provides some guidance. In paragraph 6 it states that

> "the HICP requires the representation of all currently available product-offers within the consumption segments by purpose **selected in the reference period**" (our bold)

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The principle introduced here could be called "*reference period representativity*" and is actually a logical concept in a Laspeyres-type index with a fixed product basket with weights from a reference period. Within the one-year link we should thus not aim to cover new consumption segments or new types of products but to stick to the specifications and product-offers in the reference period as much as possible.

It follows logically that replacement product offers should also represent the base period basket. For this purpose a replacement should be equivalent or at least comparable to the base period product offer. It should of course also be well sold so that it covers significant consumption values.

Comparable replacements are those that make a computation of price change possible. Either they are judged to be (essentially) equivalent for the average consumer (she is more or less indifferent between the two variants) or comparable (there is an adjustment method which is able to reflect the consumer valuation between the two).

We thus propose that the normal criteria for replacements should be, in order of priority:

i. Replacements shall be equivalent or comparable.
ii. Replacements shall be the most sold among equivalent or comparable product offers.

If there is no equivalent or comparable replacement available a product offer has to be deleted so that price change is computed over the remaining product offers. The deletion method is the same as what is used today for food items. It is clear, however, that this method breaks down too many deletions become necessary over the year.

We discuss below to which product groups this approach can be applied.

Evaluating QA methods - what is the benchmark?

Product quality is a difficult concept. It is inherently subjective since it embodies everything that consumers value in a product. There are certain intuitive ideas, which in practice constitute a common ground, when price statisticians discuss quality adjustment methods, such as:

- **(The overlap paradigm)** In competitive markets existing price differences reveal consumer valuations. If a consumer has a free choice between alternative models performing the same basic function, the price difference between them is a quality difference which shall not enter the CPI as a price change.
    - At the same time there are pitfalls in this argument. It assumes also a market equilibrium, that is a balance between supply and demand. If an old product is sold out

in a short period at low prices, the difference between this low price and the price of a new product, which may overlap the previous one for a brief period could not be fully be regarded as quality. Also one has to take care not to treat price differences between two months in this way (link-to-show-no-price-change).

- Technological products (especially consumer electronics) are often subject to more or less ongoing quality improvement so that it is normal to look for improvements in cases of replacement and to reduce the price change due to quality change. Also, price reductions for old models coexisting with new models are necessary to make them competitive with new improved products. Even if these are called sales prices and applied only in the end of the product's lifecycle it may therefore be a reflection of the quality improvements in the market and should thus be taken into account.
    - However, it should still be ascertained that there are significant quantities marketed and sold at a given price, for example a final sales price.
- More traditional products tend to have smaller changes in quality and on average quality adjustments should therefore not result in big adjustments to price change. Such products are for example clothing and textiles, non-electric kitchen utensils and furniture.
    - There can of course be sudden changes, for example new materials, which lead to a sudden jump in quality also for such products. But there needs to be clear evidence of something like this for accepting significant quality adjustments in a certain direction.

The above constitutes some kind of a priori basis for evaluating and proposing specific QA methods and approaches in different product markets.

A typology of QA methods and their use

A key distinction between QA methods is between explicit adjustments and automatic methods.

Explicit adjustments

An explicit adjustment means that the price statistician assesses each replacement situation individually and assigns a value, which is supposed to reflect the quality difference. The different methods and their usefulness are described below.

Hedonics

Hedonics means that, for a set of products with prices for a certain, common period and with data for a number of relevant characteristics, a regression analysis with price as the dependent variable, is carried out. The quality adjustment then uses the coefficients for the independent

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variables for giving a value to the quality difference between the old and the new product offer.[1]

As long as the replacement product offer only differs from the previous one with respect to characteristics in the equation this works fine. But a number of factors limits the use of hedonics in CPI practice.

- A set of products for which a hedonic model is to be used needs to be defined in advance and the hedonic model estimated. When a completely new product appears, or one that is just a bit outside the framework of the hedonic model, it still has to be brought in through some kind of overlap method (see below). This means that hedonics can only take care of a relatively small part of the whole problem of quality change anyway.

  For example smartphones replacing simpler mobile phones, surf pads replacing laptops or blueray disc players replacing DVD players are all situations where it is very hard, if not impossible, to apply timely hedonic models.
- The resources for developing and updating hedonic models are very high. The analyst working in this field needs to be an expert both in the hedonic method itself and in the product field that the hedonic model covers. Moreover, the data requirements are high and there is a myriad of methodological issues within the hedonic model itself that often have no obvious clear-cut answer.

For these reasons it can seriously be doubted that hedonics will ever become a cost effective general methodology in official price index production. Still it can be useful (i) for specific products such as computers or (ii) as an aid in assessing which characteristics are the important ones for a certain product.

Option Prices

The option price method requires a very particular situation to be at hand. This is that a replacement includes a certain feature (characteristic) as a standard that was previously available as an optional extra. It is then reasonable to take (usually 50 % of) the price of the optional extra as the value of the quality difference. What is also required is that everything else is the same.

This situation appears only to exist for cars and some other transport equipment. For example for home electronics, new models are bundled with respect to many different characteristics at the same time which makes it impossible to apply the option price method.

[1] Other ways of using hedonics exist as well such as the time dummy method where the price change is estimated directly from the regression. In the CPI context these other approaches are problematic and not often (never?) used.

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Other supported adjustments

Occasionally some tailor-made adjustment method can be invented for a certain quality characteristic. An example is fuel consumption for cars. Such methods are by definition unique for a certain product and partial with respect to all quality differences.

A common type of adjustment that should be mentioned is the *volume* (package size) *adjustment* where the only difference between the old and the new product offer is its quantity. This is mainly applicable in the food area but could occasionally be applicable also for other products.

Unsupported adjustments

The CENEX report recommends against so called unsupported adjustments. On page 45 it states (regarding TVs): "Unsupported judgement is assessed as a C-method." (C-method stands for *not acceptable*.) Unsupported judgement is in contrast to supported judgement (page 38-39) where a specific characteristic of the product (e.g. energy consumption of an electrical appliance or fuel consumption of a car) is taken as the basis for a quality adjustment.

Interviewer judgement is clearly an example of unsupported judgement in the CENEX sense. If it were to count as a supported adjustment some evidence would have to be presented that it can somehow serve as a proxy for the average consumer evaluation. No such evidence exists and, as the empirical analysis below shows, it can rather be feared that we could prove the contrary.

Methods using the overlap principle

The matched model method is at the heart of the measurement philosophy in price indexes. This method simply means that like should be compared with like and averages taken over all comparisons. In order to address the dynamic universe new products/product offers/outlets need to be introduced according to a certain methodology. New entities cannot generally be compared with old entities which means that some kind of overlap technique is useful. In practice overlap techniques show up in several different disguises of which some are and some are not at present used in the CPI.

In practice overlap techniques take care of the bulk of the product and outlet changes over time with only a small part left to explicit adjustments. This is an unavoidable fact. Still, one has to ask the question if the overlap paradigm is applicable in any such case. Can it reasonably be assumed that the price differences between the old and the new product offers are equal to their quality differences or is there a risk of bias built into these techniques?

Simple overlap (not used today)

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The simplest and most basic way in which the overlap method can be used is by observing, in the same month, both the old and the new product offer.

In practice this method is rarely used in the CPI, for practical reasons. When the old product offer disappears we would need the price of the new product offer already from the previous month and this is normally not easy to obtain.

Bridged overlap
In its basic form the bridged overlap means that, between any two months where product offers are not identical/equivalent/comparable price change is estimated over the remaining product offers. Calculations over several months are in principle done through a monthly (pseudo-) chaining procedure, although mathematical tools can be used for using this method in other settings.

Monthly chaining and re-sampling (mcr)
The mcr method is computationally the same as the bridged overlap. But in its strict form it implies a more aggressive monthly re-sampling procedure. Applied to the whole universe it means that all models/varieties in the outlets are included in the index from the first to the last months in which they are significantly sold. In its ideal form transaction-based weights should also be somehow applied.[2] No one-to-one replacements are applied – each model stands on its own as long as it is sold. Unlike the bridged overlap only identical models (in principle **not** the equivalent or comparable ones) enter the calculations.

Deletion
Deletion means that the product offer is not replaced at all for the rest of the link. Price change will only be computed over the remaining identical/equivalent/ comparable product offers. In effect this may be seen as a special type of bridged overlap.

Overlap in chain link months
In December every year a new sample of outlets and new product specifications are introduced. To the extent that they are new their introduction will be according to the overlap principle.

Partial re-sampling (not used today)
In any month of the year a completely new sample of products or outlets could be selected. Or for one product a new specification could be introduced leading to whole new set of product offers. In the overlap month both prices have to be collected both for the old and the new sample.

Patterns in CPI data

[2] As far as known, a precise theoretical target parameter has not been proposed for the mcr method.

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Sales prices and price reductions

Sales prices are generally in scope for the CPI, according to EU and international recommendations. The CPI is supposed to take into account what people actually pay so this rule is conceptually correct. However, it also gives rise to an extra challenge for replacement and QA procedures. The issue can be illustrated by a simple time series for a single product offer in an outlet:

Table 1: Example of an rsr-cycle

Month	0	1	2	3	4	5	6
Price	195	195	195	99	99	225	225

The interviewer chooses a product offer in base December (month 0) with a regular price of SEK 195. In months 1-2 the price is not changed but in month 3 it goes on sale at about half the price and remains on sale in month 4. In month 5 it disappears and is replaced by a new product offer with a different quality, sold at SEK 225 kr. How should quality adjustment be carried out? One could generalise this example to call it a **regular price-sales price-replacement** (**rsr**) cycle.

The reason that this pattern creates great problems for price measurement is its asymmetrical nature. Price decreases typically occur within the life-time of one product offer but the price increase occurs exactly at the replacement.

It is immediately clear that when rsr cycles occur for products with no or little overall quality change the average quality adjustment from a sales price to a replacement price has to be small relative to the price increase, i.e., most of the price change has to go into the index. If instead a bridged overlap is applied in these cases, a price change of close to 1 would be implicitly imputed and this would lead to a devastating downward bias in the index.

This issue is complicated considerably by the difficulty of defining a sales price. Today sales prices are prices with any of the following Swedish labels: *reapris, extrapris, kampanjpris* (other labels may also occur). However, interviewers have difficulties in giving consistent labels. For example a sales price that continues for several months is often coded as a regular price in later months. This means that what is in reality an rsr cycle is in the analyses below sometimes coded as a “pure price decrease”.

The quality adjustment applied in the end of an rsr cycle then often effectively eliminates some of the price increase back to the previous price level by interpreting the replacement product as being of higher quality. If there is no average quality change in the data a downward bias results.

In the next two tables we provide two examples of rsr cycles at the outlet level, one for curtain cloth and one for large TVs.

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Table 2: Example of price observations in one outlet 2010-2012, curtain (cloth)

LivNr	Ar	Period	PrisSignal	ObsPris	OmrBasPris	KvalBelopp
2872	2010	0	11	109	109	
2872	2010	1	02	54,5	109	
2872	2010	2	01	109	109	
2872	2010	3	11	109	109	
2872	2010	4	11	109	109	
2872	2010	5	11	109	109	
2872	2010	6	11	109	109	
2872	2010	7	11	109	109	
2872	2010	8	11	109	109	
2872	2010	9	11	109	109	
2872	2010	10	11	109	109	
2872	2010	11	11	109	109	
2872	2010	12	11	109	109	
2872	2011	1	11	109	109	
2872	2011	2	13	79	109	
2872	2011	3	11	79	109	
2872	2011	4	13	59	109	
2872	2011	5	13	59	109	
2872	2011	6	11	59	109	
2872	2011	7	11	59	109	
2872	2011	8	11	59	109	
2872	2011	9	11	59	109	
2872	2011	10	11	59	109	
2872	2011	11	11	59	109	
2872	2011	12	11	59	109	
2873	2012	1	21	129	99	40
2873	2012	2	11	129	99	
2873	2012	3	11	129	99	
2873	2012	4	11	129	99	
2874	2012	5	21	119	99	0
2874	2012	6	11	119	99	
2874	2012	7	11	119	99	
2875	2012	8	22	111,2	99	0
	Price index			**2010**	**100**	
				2011	**54,1**	
				2012	**112,3**	
				2010-2012	**60,8**	

Erroneously coded as a regular price

Replacement with sharp price increase

Quality adjustment removes 57 % of price increase

Chained price index, goes into CPI but prices actually increase from 109 to 111.2.
Quality improvement??

Comment to Table 2: The same price level throughout the period with a 2 % price increase. QA in January 2012 removes about half of the price increase. Is quality of curtain cloth improving or not?

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Table 3: Example of price observations in one outlet 2010-2011, large TV

LivNr	Ar	Period	PrisSignal	ObsPris	OmrBasPris	KvalBelopp
10849	2010	0	01	17632	17632	
10849	2010	1	01	16995	17632	
10849	2010	2	11	16995	17632	
10849	2010	3	11	16995	17632	
10849	2010	4	11	16995	17632	
10849	2010	5	11	16995	17632	
10850	2010	6	21	12995	17632	0
10850	2010	7	02	9995	17632	
10850	2010	8	12	9995	17632	
10850	2010	9	01	10995	17632	
10851	2010	10	21	8995	17632	0
10852	2010	11	21	9995	17632	0
10853	2010	12	21	9995	17632	0
10854	2011	1	21	6995	7995	-2000
10854	2011	2	11	6995	7995	
10854	2011	3	11	6995	7995	
10854	2011	4	11	6995	7995	
10854	2011	5	11	6995	7995	
10854	2011	6	11	6995	7995	
10854	2011	7	11	6995	7995	
10855	2011	8	21	9995	11424	3000
10856	2011	9	21	6990	10738	-600
10857	2011	10	21	9995	15347	3000
10858	2011	11	21	10490	16107	495
10859	2011	12	21	6990	13036	-2000
Price index			**2010**	**56,7**		
			2011	**53,6**		
			2010-2011	**30,4**		

Five consecutive months with replacements and QA. Total QA=+3895 SEK. Note that prices in months 7 and 12 are almost equal.

Comment to Table 3: A TV model starts out with a high price in December 2009. A number of replacements occur in the last half of 2010, all of which are judged to be of equal quality. A replacement in the beginning of 2011 is done for which the quality is judged to be lower and so partially offsetting the price reduction. The suspicious part occurs in the end of 2011 where five consecutive replacements with prices bouncing up and down are judged to lead to a net quality improvement of SEK 3895 with the price level staying the same (going from SEK 6995 to SEK 6990).

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Tables 2-3 are included in order to provide some intuition into the problems of quality adjustment in practice. The tables give an idea of what the microdata look like. Typical features are (i) the large price changes up and down where 50 % change or more in the price level are normal, (ii) the downward movements from a regular price to a lower sales price and (iii) the often large price increases at replacements. It goes without saying that these kinds of patterns present great challenges to price index estimation.

Implicit quality indexes (IQI)

An important tool for analysing QA methods is the so called Implicit Quality Index (IQI) defined by dividing the Average Price Change[3] (APC) by the Adjusted Price Index (API, after applying a certain QA method) or:

$$IQI = \frac{APC}{API}$$

The IQI shows what the implied quality change in the sample is that results in the actual price index. Given that the sample is representative of the universe of products the IQI also tells us about the implied quality change in the universe. This sample/universe aspect is important to keep in mind when analysing IQI numbers. It could be that in a certain case a strange-looking IQI could be due to a sudden change in the sample (for example a new product specification could have been introduced).

Table 4: IQI for actual index produced and for the bridged overlap method, 2010-2012

Product group	*2010, actual*	*2010, bridged overlap*	*2011, actual*	*2011, bridged overlap*	*2012, actual*	*2012, bridged overlap*
Furniture	100.5	100.9	100.9	103.3	100.8	102.4
Household textiles	104.5	115.5	103.7	122.0	101.0	120.9
Household appliances	101.0	108.3	105.8	106.5	103.2	105.4
Household equipment	103.9	110.8	103.9	109.9	100.1	98.0
Tools for home and garden	104.5	107.8	104.4	103.5	101.6	102.4
Recreational goods	102.2	112.7	100.9	108.5	103.8	109.1
Home electronics	107.7	113.0	111.8	114.2	111.0	119.1
Large TVs	111.0	117.1	113.7	115.3	111.5	116.2
Digital cameras	97.8	100.1	110.9	112.1	121.0	147.4
DVD players	107.2	114.8	106.6	113.1	111.3	117.2

[3] Various detailed ways of calculating the APC need to be considered in each case.

Almost all IQIs are above 100 meaning that quality adjustment methods imply an improved average quality. For high-tech goods this is in line with our expectations but for household textiles and household equipment the high IQIs for 2010-2011 look more suspicious, especially with Example 2 above in mind. Here we are dealing with everyday things like bed sheets, curtain cloth and kitchen utensils, where we do not expect significant overall quality changes.

Applying the bridged overlap almost always increases the IQI, often substantially. With Tables 2-3 in mind it is easy to see why. Replacements are often connected with large price increases. If the bridged overlap is used for these replacements a large price increase will be replaced by the small price movements for identical product offers. At the same time the price decreases going from regular to sales prices will remain in the index. A probably large downward bias results.

Product offer lives

In this section we introduce the concept of a *product offer life*. This is the time span during which a narrowly defined product offer remains in the sample. In Tables 2-3 each product offer life has a number called *LivNr*. For example in Table 3 the data series include 11 such lives numbered from 10849 to 10859. (Table 2 includes four lives.)

In Table 5 a product offer life time is defined as the number of months an identical product offer is included in the CPI data base. This concept is related to its market life but is not exactly equal to it, for two reasons. Firstly, the product offer may have been sold for some time before it is included in the CPI. Secondly, it may end its CPI life before its market life due to being linked out in December or continuing after 2012. So the market life is generally longer than the CPI life.

In Table 5 we show the average length of the life cycles. As expected they are the smallest for technological products but it is noteworthy that also some of the more traditional tech products like TVs have as short lives in the market as computers and mobile phones. Other products (except seasonal products like ski equipment) mostly remain in the market/sample[4] about a year.

Table 5 shows the average lengths of product offer cycles from 2009 to 2012, a period of 48 months. For ordinary household equipment, textiles and furniture the life is around 12 months in the data which gives on average one replacement each year. For home electronics, the average life span is much shorter than a year and in case of TVs only 4-5 months so here we can expect several replacements within a year, about the same as for computers and mobile phones for which the mcr method is now used. Recreational goods including sport equipment have a life of less than a

[4] It should be noted that we do not make a distinction between end of life cycle due to (i) actual discontinuation of a model and (ii) end of year.

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year with ski equipment, a seasonal good being a case needing special attention. Household appliances have life times of 6-9 months.

Table 5: Average length of a product offer life cycle in months for selected products, 2009-2012[5]

Product	*Months*	*Product*	*Months*	*Product*	*Months*
Plate	12.9	Flower, plant	15.7	Video camera	4.8
Coffee cup	10.8	Ski equipment	3.8	Audio systems	6.0
Glass	10.7	Sport equipment	7.5	Home cinema system	6.1
Eating knife	19.2	Outdoor recreation equipment	10.4	CD radio	6.0
Saucepan	14.2	Toy	11.6	MP3 player	6.8
Kitchen knife	17.2	Kitchen table	15.5	Game console	9.0
Kitchen scale	14.4	Unupholstered chair	14.4	Digital camera	5.9
Salad bowl	12.7	Upholstered chair	14.3	Computer	3.5
Baby carriage	11.8	Bed	16.9	Mobile phone	5.6
Baby car seat	17.2	Ceiling lamp	14.3	Washing machine	6.0
Bag, case, purse	6.6	Armchair	15.5	Dishwasher	7.0
Towel	13.5	Sofa	13.0	Vacuum cleaner	7.4
Duvet cover set	9.7	Shelf, cabinet	17.0	Refrigerator	6.3
Curtain (cloth)	10.0	Carpet	12.8	Microwave oven	8.9
Quilt	14.0	Mattress	23.2	Coffee maker	9.6
Car tyre	15.3	Mirror	16.9	Water boiler	9.0
Car accessory	20.2	TV, small	4.3	Watch	19.0
Bicycle	11.0	TV, large	4.3	Jewellery	20.8
Musical instrument	11.6	DVD player	5.2		

Table 6 provides statistics on the product lives by product group. To explain the Table: For plates there are 346 lives in the data of which 8.7 % are *rsr* lives, 22 % pure price decreases, 9.4 % price increases and 59.9 % other patterns. (Other patterns are mostly lives with no price changes but also lives that last only one month and other odd patterns.)

[5] There is a certain ”truncation bias” in these numbers since (i) lives in the end of the period will in fact continue for a number of months and (ii) some outlets leave the sample in December.

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Table 6: Statistics on product-offer lives for products with interviewer judgement, 2009-2012

Group/ product group (w = weight, n = total number of lives)	**Rsr, pure price decrease**		**Pure price increase**		**Other patterns**	
	%	*Median price change per month*	%	*Median price change per month*	%	*Median price change per month*
Household equipment						
Plate (w = 0.69, n = 346)	8.7, 22	0.92, 0.99	9.4	1.01	59.9	≈ 1
Coffee cup (w = 0.74, n = 205)	13.6, 6.6	0.91, 0.98	8.7	1.01	71.2	≈ 1
Glass (w = 0.67, n = 59)	7.1, 7.3	0.82, 0.97	29.2	1.01	56.3	≈ 1
Eating knife (w = 0.34, n = 27)	4.2, 7.3	0.91, 0.99	23.5	1.01	64.9	≈ 1
Saucepan (w = 1.06, n = 97)	7.1, 6.2	0.97, 0.99	17.0	1.00	69.7	≈ 1
Kitchen knife (w = 1.06, n = 77)	7.4, 17	0.95, 0.99	18.0	1.01	57.6	≈ 1
Kitchen scale (w = 1.06, n = 82)	0.4, 0.0	0.95, .	14.2	1.01	85.3	≈ 1
Plastic food container (w = 1.06, n = 103)	1.2, 12.9	0.96, 1.00	26.5	1.01	59.4	≈ 1
Salad bowl (w = 1.06, n = 78)	5.5, 0.0	0.94, .	38.7	1.01	55.7	≈ 1
Other personal goods						
Baby carriage (w = 0.31, n = 193)	15.9, 10.1	0.98, 0.99	38.8	1.00	35.2	≈ 1
Baby car seat (w = 0.32, n = 94)	7.3, 5.5	0.97, 0.99	45.1	1.00	42.1	≈ 1
Bag, case, purse (w = 1.92, n = 388)	12.3, 3.5	0.89, 0.97	20.9	1.01	63.2	≈ 1
Household textiles						
Towel (w = 0.41, n = 305)	18.3, 16.5	0.94, 0.99	22.9	1.01	42.2	≈ 1
Duvet cover set (w = 1.15, n = 526)	26.2, 4.6	0.93, 0.96	9.4	1.02	59.8	≈ 1
Curtain (cloth) (w = 2.89, n = 548)	20.6, 7.1	0.9, 0.98	20.5	1.01	51.8	≈ 1
Quilt (w = 1.19, n = 171)	13.6, 4.2	0.98, 0.98	30.8	1.01	51.3	≈ 1
Car accessories						
Car tyre (w = 4.21, n = 230)	5.6, 32.0	1, 0.99	41.8	1.00	20.6	≈ 1
Car accessory (w = 1.29, n = 269)	6.2, 12.8	0.99, 1	55.1	1.00	25.9	≈ 1
Recreational goods						
Bicycle (w = 1.61, n = 213)	18.0, 7.6	0.98, 0.98	26.8	1.01	47.6	≈ 1
Musical instrument (w = 0.77, n = 44)	20.9, 1.4	0.99, 0.98	18.4	1.01	59.4	≈ 1
Flower, plant (w = 4.97, n = 606)	2.6, 23.6	0.98, 0.99	41.7	1.01	32.1	≈ 1
Ski equipment (w = 0.81, n = 193)	19.1, 1.5	0.92, 0.87	9.6	1.01	69.8	≈ 1
Sport equipment (w = 3.15, n = 479)	23.1, 3.0	0.95, 0.99	6.1	1.02	67.8	≈ 1
Outdoor recr. equipment (w = 1.37, n = 127)	10.2, 2.1	0.97, 0.99	19.7	1.01	68.0	≈ 1
Toy (w = 4.85, n = 526)	7.5, 6.7	0.93, 0.99	30.2	1.01	55.6	≈ 1
Furniture						
Kitchen table (w = 1.48, n = 143)	6.5, 12.7	0.97, 1.00	44.5	1.00	36.3	≈ 1
Unupholstered chair (w = 1.18, n = 146)	8.3, 13.2	0.97, 0.99	28.6	1.01	49.9	≈ 1
Upholstered chair (w = 1.18, n = 151)	3.1, 22.9	0.96, 0.98	38.7	1.01	35.3	≈ 1
Bed (w = 2.90, n = 279)	7.8, 15.4	0.97, 0.99	27.2	1.00	49.6	≈ 1
Ceiling lamp (w = 2.21, n = 193)	11.8, 2.2	0.96, 0.99	35.3	1.00	50.7	≈ 1
Armchair (w = 1.17, n = 144)	3.7, 11.3	0.96, 1.00	31.2	1.00	53.9	≈ 1
Sofa (w = 3.82, n = 349)	7.4, 22.9	0.97, 0.99	30.6	1.01	39.2	≈ 1
Shelf, cabinet (w = 2.65, n = 242)	13.8, 14.7	0.97, 0.99	31.8	1.01	39.6	≈ 1
Carpet (w = 1.57, n = 174)	19.2, 3.6	0.97, 0.97	10.9	1.01	66.2	≈ 1
Mattress (w = 0.51, n = 31)	0.4, 40.0	0.84, 1.00	21.0	1.00	38.6	≈ 1
Mirror (w = 3.66, n = 86)	4.5, 4.7	0.98, 0.99	12.4	1.00	78.4	≈ 1
High-tech products						
TV, small (w = 0.29, n = 239)	20.1, 23.8	0.94, 0.98	9.7	1.03	46.5	≈ 1
TV, large (w = 5.55, n = 498)	16.9, 31.4	0.95, 0.96	4.2	1.03	47.5	≈ 1
DVD player (w = 0.85, n = 468)	17.2, 24.7	0.95, 0.98	5.2	1.03	52.9	≈ 1
Video camera (w = 0.18, n = 250)	21.5, 24.7	0.93, 0.96	6.3	1.04	47.5	≈ 1
Audio system (w = 0.29, n = 335)	11.2, 21.1	0.98, 0.98	4.8	1.01	62.9	≈ 1
Home cinema system (w = 0.32, n = 153)	25.4, 21.8	0.96, 0.98	10.5	1.02	42.3	≈ 1
CD radio (w = 0.11, n = 140)	10.0, 18.9	0.96, 0.97	6.4	1.01	64.7	≈ 1
MP3 player (w = 0.64, n = 289)	10.2, 30.8	0.96, 0.98	5.9	1.03	53.1	≈ 1
Game console (w = 0.54, n = 76)	2.9, 65.9	0.95, 0.98	7.3	1.02	23.8	≈ 1
Digital camera (w = 1.63, n = 615)	24.4, 35.9	0.95, 0.97	5.4	1.02	34.3	≈ 1
Computer (w = 5.24, n = 2035)	11.6, 33.6	0.96, 0.97	8.4	1.02	46.4	≈ 1
Mobile phone (w = 5.28, n = 1821)	6.3, 43.2	0.96, 0.97	16.2	1.05	34.3	≈ 1
Household appliances						
Washing machine (w = 0.82, n = 263)	23.2, 19.1	0.98, 0.98	16.0	1.02	41.8	≈ 1
Dishwasher (w = 0.59, n = 173)	17.2, 17.1	0.98, 0.98	15.7	1.01	50.0	≈ 1
Vacuum cleaner (w = 0.40, n = 360)	13.3, 18.1	0.96, 0.98	17.8	1.01	50.8	≈ 1
Refrigerator (w = 0.40, n = 196)	12.4, 16.0	0.97, 0.99	15.9	1.02	55.7	≈ 1
Microwave oven (w = 1.20, n = 227)	10.9, 16.0	0.98, 0.99	21.6	1.01	51.4	≈ 1
Coffee maker (w = 1.73, n = 399)	16.6, 20.7	0.97, 0.98	13.8	1.01	48.9	≈ 1
Water boiler (w = 0.33, n = 481)	7.0, 14.5	0.98, 0.98	14.5	1.01	64.1	≈ 1
Other personal goods						
Watch (w = 1.67, n = 119)	4.3, 1.8	0.98, 0.95	36.0	1.01	58.0	≈ 1
Jewellery (w = 2.12, n = 92)	6.8, 1.0	0.99, 0.99	71.6	1.01	20.5	≈ 1
Restaurants						
Lunch, restaurant (w = 22.30, n = 344)	0.0, 9.5	., 1.00	48.7	1.00	41.8	≈ 1
Lunch, cafeteria (w = 2.45, n = 56)	0.0, 0.0	., .	83.7	1.00	16.3	≈ 1

The median monthly price change for rsr lives is 0.92 for pure price decreases 0.99, for price increases 1.01 and for other patterns 1.00.

In fact, due to coding mistakes mentioned in connection with Table 2 an unknown share of the pure price decreases are actually rsr lives, a reason for grouping these together.

We make a number of observations in Table 6:

- Most product offer lives involve no price change at all or very small ones. (The category "other patterns" is dominated by lives with a constant price or with a life of only one month. Other small categories are "from sales price to regular price" and "from sales price to sales price" with very small price changes on average.) Inflation tendencies are thus mainly to be estimated from the first three types of lives and from the replacements between two lives.

- For high-tech products, the price decreases far outnumber the increases whereas the median price decreases (at around 0.97) are in the same order as the increases (at around 1.03). Similar patterns appear for Household appliances – a group that includes some "medium-tech" electrical devices.

- For other products the patterns are more mixed and in most cases price increases are more numerous than decreases. Median monthly increases are small, however, indicating that price increases within a product life are seldom large (often 1.01) in contrast to price decreases which are often large (with Bag and Curtain cloth being the most extreme with rsr decrease of 0.89-0.90).

Price decreases are a reflection of the rapid technological change. We can normally assume that there will be some quality improvements when a new product offer replaces an old one. But are improvements be so great so as to fully offset the price increase when going from a sales price to a regular price? This is the assumption underlying the mcr method.

Methodological consequences

The analysis in the empirical section above shows that a sound methodology needs to take into account the very particular product-offer lives and price cycles in the data. The fact that replacements are inseparably connected to sales prices and rsr patterns is a key feature of the data and has to be taken into account when an appropriate methodology is designed.

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Especially it is clear that the bridged overlap would lead to a serious underestimating bias if applied in situations with a sharp price increase following a sales price. In effect most of the price increase would be unaccounted for.

We therefore propose two methodologies, one to be applied for most products and one that is designed for high-technology products only.

Methodology for most products

For most products, those where product offer life times are around a year or more and where overall quality change is expected to be slow, we propose a measurement strategy based mainly on direct price comparisons and the principle of base period representativity. In more detail we suggest the following:

- Product specifications are determined for any new year and will in practice not need to be changed every year.
- Replacements are primarily made on the basis of *essentially equivalent* (sufficiently similar) for direct price comparisons to be used.
- As a second replacement criterion the replacement should be well sold. In principle the most sold among the essentially equivalent product offers should be chosen.
- If no essentially equivalent product offer is available the product offer is deleted and price change computed over the remaining product offers.
- In case a supported QA method is available for a certain product the criterion *essentially equivalent* is changed to *comparable under the QA method*.

It should be noted that today the interviewers assign a quality difference of zero to 57 % of all replacements. (26% are considered quality increases and 17 % quality decreases) Thus it is not expected to be difficult in general to find essentially equivalent replacements in practice. This is of key importance since this methodology break down if too many product offers are deleted. This fact also provides some hints as to suitable instructions concerning essentially equivalent replacements. The interviewer could be instructed to choose a replacement where she would feel comfortable to assign a quality difference of zero. It is generally dangerous to take a too strict view on what is to count as essentially equivalent but this could vary from product to product. Under the assumption of small overall quality change one might be willing to accept that a single replacement could have somewhat different quality if one can feel assured that these differences roughly cancel for the sample as a whole. This can in turn be checked through an IQI analysis.

The great advantage from this approach is the reduction in bias risk resulting from enforcing like with like replacements. Representativity with regard to the base period will still be achieved and wide product

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specifications, allowing for a broader spectrum of varieties to be selected in outlets will further guarantee this.

The methodology covers cases where a supported quality adjustment is available by allowing for comparable replacements. It could be an option price or possibly a quantity (package size) adjustment or something else.

Even with this strategy the sales price problem is not completely resolved and from the point of view of the accuracy of the CPI this is likely to be the most important issue of all. If there is a tendency to start with regular prices in December but having many sales prices in the end of the year a serious bias can result. One possibility to reduce this bias is to adopt a sales price correction similar to the one used for clothing, where the index is adjusted by the differential in the effects of sales prices in December t-1 and December t. Another, perhaps better, idea is to have the interviewers start price collection for a new product specification or a new outlet in October already, whereas these product offers will not be included until December. After two months one can hope that sales prices will no longer be underrepresented as they tend to be in the first period measurement period. There are also other options here, such as giving the interviewers very precise instructions on how to choose the most sold product offer in the base period and to take no account of whether it is expected to last long in the outlet.

A rule is also needed as to when a replacement should be done. Temporary unavailability should not cause an immediate replacement. If the interviewer has reason to believe that a certain product offer is only temporarily unavailable it should be coded as such and the previous price carried forward.[6] After a maximum of three months of unavailability a replacements has always to be done.

The methodology in this section is proposed to cover the following product groups. The detailed proposal shown in Annex 1. Products in these groups all have relatively long product lives (usually around a year) and are expected to show slow quality change. Some products are seasonal with no availability in certain months, which can lead to special problems that are not dealt with here.

- Furniture
- Household textiles
- Household goods
- Tools and garden equipment
- Household equipment
- Other recreational goods
- Restaurants
- Other personal goods

[6] A bridged overlap is statistically slightly better in such cases but probably more cumbersome to fit into the present IT system.

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There are some branded products within these groups that are more technical in nature. Examples are microwave ovens, coffee makers or grass mowers. For these kinds of products one has to be more careful with treating replacements as essentially equivalent since each new model often has distinctly new features. Still product cycles are normally quite long so that they can be expected to often stay in the sample over a year and deletion will be acceptable in those cases where they don't. If a certain product shows a more fast-moving behaviour, it could later be considered to apply the mcr method for high technology products described below.

A change to this methodology requires new instructions to interviewers and probably only minor adjustment in the IT system will be necessary. It appears to be possible to apply it with relatively short notice.

Methodology for high-technology products

At present the mcr method is used for computers and mobile phones and interviewer adjustment for other home electronics products, which belong to the high-technology category. The similarity in the length of product lives and the share of price decreasing cycles is an argument for using the same method for all machine-type products in this group (not discs with cultural content).

Because of the short life-time of these products, it is necessary to use a different method than for most products. The method described above would break down due to too few essentially equivalent replacements and would not be able to reflect the quality change.

More background on the present methods

In order to gain some further understanding on the effects of interviewer adjustment methods we look at the actual index outcomes for some products in 2010-2012. Results for TVs are really extreme. Could it really be true that prices have gone down by 80 % in 2½ years? Price reductions for computers are somewhat smaller but also larger than would be expected.

Table 7: Price indexes for selected high-tech product

	TV, large	TV, small	Computers	DVD-player	Coicop 09.1
2010	53,1	55,3	64,0	72,8	70,8
2011	54,9	61,0	60,6	72,7	70,8
2012, July	62,1	66,4	68,0	72,9	73,8
2010-2012, July	18,1	22,4	26,4	38,6	37,0

To gain more perspective to these numbers we looked at HICP indexes for all EU Member States for Coicop groups to which TVs belong. In 09.1.1

TVs can be expected to dominate by weight. In 09.1 also computers etc. (but not mobile phones) are included. We see that Sweden comes out in the extreme low end of both comparisons and most extremely so in 09.1.1 where TVs dominate. It can be seriously expected that this outcome is to a large extent methodology driven, although we know of course that market competition in this area has been fierce in Sweden, perhaps more so than in other countries?[7]

The extreme results in Tables 7-8 are reasons to move to a better methodology without unnecessary delay but also be very careful when designing a new methodology.

[7] From looking at Tables 7 and 8 together it would appear that almost the whole index decrease would have happened in 2010-2012 and very little in 2005-2009. We have not had time to look further into this anomaly.

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Table 8: HICP August 2012 for EU Member States for Coicop groups where TVs belong

09.1.1 Equipment for the reception. recording and reproduction of sound and pictures		09.1 Audio-visual. photographic and information processing equipment	
Country	HICP (2005=100)	Country	HICP (2005=100)
Sweden	27.6	Sweden	40.3
France	37.4	Estonia	44.0
Czech Republic	39.4	Ireland	45.5
Estonia	39.6	Spain	46.0
Belgium	43.7	Latvia	46.8
Latvia	41.8	Czech Republic	47.6
Slovakia	42.3	Switzerland	47.6
Ireland	43.5	France	48.0
Lithuania	42.7	UK (July)	48.2
Spain	43.4	Lithuania	51.6
Netherlands	45.1	Finland	52.9
Poland	45.3	Poland	53.5
UK (July)	47.6	European Union	53.9
European Union	47.9	Belgium	54.1
Euro area	48.4	Euro area	55.9
Slovenia	48.7	Netherlands	56.6
Turkey	50.0	Portugal	56.6
Finland	51.1	Slovakia	57.0
Cyprus	51.6	Croatia	57.8
Switzerland	52.4	Denmark	59.1
Portugal	52.8	Slovenia	59.5
Hungary	53.9	Hungary	59.5
Germany	56.6	Cyprus	61.8
Denmark	58.0	Austria	62.2
Norway	59.4	Italy	62.5
Bulgaria	65.7	Norway	64.1
Italy	65.5	Germany	67.1
Greece	70.9	Turkey	67.6
Austria	70.1	Bulgaria	69.4
Luxembourg	71.0	Greece	75.2
Croatia	73.8	Luxembourg	80.7
Malta	86.7	Malta	82.9
Iceland	90.0	Romania	89.2
Romania	94.6	Iceland	98.1

The new mcr method

The only available option for high-tech products appears to be the mcr method. It is not unreasonable to assume that the price differences between different models in a certain month reflect consumer preferences

and quality differences. This is the assumption needed in order to legitimate the mcr method. The way the method is now applied to computers and mobile phones is, however, doubtful. The monthly re-sampling element is not really applied as intended and instead a one-to-one replacement practice is used. This means that new products are not necessarily included from the beginning of their active life time.

It is therefore proposed to move to a more rigorous variant of the mcr method, where genuine re-sampling takes place every month. Another issue with the mcr method is that prices in a product offer life do not represent equal sales quantities. Efforts should therefore be made during price collection to ascertain that a price represents a "normal" sales quantity. Clearance sales prices, where the last few units of a product offer are sold out should not be accepted. On the other hand a price reduction that is still connected with large sales volumes should be included.

It should be noted that the present interviewer judgement method gives more extreme and incredible results than the mcr method and with much less conceptual support. Despite the uncertainties surrounding the best way to apply the mcr method, the best approach is still to move to it and do the necessary research and fine-tuning in parallel.

We propose roughly the following rules for using the mcr method.

- Product offers are selected in the base period on the basis of being among the ***n*** most sold in the outlet according to a wide product specification. Most sold should ideally relate to a full month and not a much shorter period and to the price as recorded by the interviewer.
- They are kept in the index as long as they are well sold. This fact has to be established each month. A proxy for well sold may be that it is displayed as a volume product.
- In each month new product offers are included regardless of whether the old ones have terminated. They are included on the basis of being among the ***n*** most sold. The sample size in each outlet will vary over months but should on average be ***n***.
- The index is computed through monthly links (m-1 to m) including only identical product offers, no "essentially equivalent" ones.

A handful of large national chains dominate the market for home electronics. They can be expected to apply very similar prices all over the country. One can therefore safely assume that the regional dimension in the area of home electronics is of very minor importance compared with the measurement problems discussed here. SCB should therefore seriously consider to limit price collection to Stockholm, at least during a transitional period, and central staff persons should be heavily involved in price collection by accompanying interviewers in the outlets so as to see how instructions are followed and successively improve those. The best combination of web prices and outlet prices should be sought. In order to

gain a better understanding of pricing patterns, weekly price collection could for example be carried out for research purposes.

The recommended approach would need some central staff resources for a while. They should be available since the dismantling of interviewer judgements will reduce other costs considerably.

Concluding comments for discussion

The above analysis was especially targeted at the Swedish situation where the price collector valuation method is broadly used. We conclude by pointing at the issues that we believe is of general international relevance.

The prevalence of rsr-cycles. Without a strong basis in data we believe that **regular price-sales price[8]-replacement** cycles occur in large frequencies in the consumer markets of most developed countries. Many types of products are involved. How should CPI methodology handle these cycles? It is clear that sales prices have to be taken into account. For product groups where quality change is small and slow the price increase associated with a replacement on average has to fully influence the index. Else an underestimating bias will inevitably result. Is there any other robust way to ensure this than to prescribe replacements that are essentially equivalent, i.e., of roughly the same consumer value as their predecessors?

Note that the **bridged overlap** method fails due to a severe underestimating bias for products with rsr patterns.

Representativity in a price index should refer to the base period and the sample drawn/selected from this period. From this follows that also the replacement should represent the reference period rather than the current period. The first replacement criterion should therefore be *essentially equivalent* to the base period product offer and only the second criterion should be *most sold*. (In practice various rules of thumb need to be formulated based on the general criteria.) However this approach breaks down for fast-moving products.

It cannot be expected that **explicit adjustments** such as hedonics, option prices and other methods can cover the bulk of quality changes in CPIs in the near future. The resources needed for hedonics are simply too big, since different models for a large number of products would be needed which would also need continual updating. A myriad of detailed issues in hedonic model-making further complicates matters.

For fast-moving products such as those in home electronics the only reasonably simple and robust method seems to be the **mcr method**. Its accuracy depends, however, critically on the overlap assumption. One must be able to accept that the price decrease in the short life-time of a

[8] Sales price is used in a wide sense here to describe any type of significant price reduction from a high initial price.

product offer reflects its quality decline relative to new models. Issues regarding when the appropriate time to introduce a new model as well as when to discontinue it are of critical importance since they will have a large influence on the index.

Our summary conclusion is that, for products where the rsr pattern is frequent, replacements and quality adjustments in CPIs have to be handled either by essentially equivalent replacements or by the mcr method.

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Annex 1 Suggested QA methodology, by product group

Product group Code	Name	Weight, ‰	Current QA method	Suggested QA method
6209	Car tyre	4.21	Interviewer judgement	Direct comparison
6218	Car accessory	1.29	Interviewer judgement	Direct comparison
6219	Car wash	2.58	Direct comparison	Direct comparison
	Car accessories	**8.08**		
5101	Eating table	1.48	Interviewer judgement	Direct comparison
5102	Unupholstered chair	1.18	Interviewer judgement	Direct comparison
5103	Upholstered chair	1.18	Interviewer judgement	Direct comparison
5107	Bed	2.90	Interviewer judgement	Direct comparison
5111	Ceiling lamp	2.21	Interviewer judgement	Direct comparison
5114	Armchair	1.17	Interviewer judgement	Direct comparison
5133	Sofa	3.82	Interviewer judgement	Direct comparison
5134	Shelf, cabinet	2.65	Interviewer judgement	Direct comparison
5135	Carpet	1.57	Interviewer judgement	Direct comparison
5201	Mattress	0.51	Interviewer judgement	Direct comparison
5213	Mirror	3.66	Interviewer judgement	Direct comparison
	Furniture	**22.33**		
6416	Mobile phone	5.28	MCR	MCR
7105	TV, small	0.29	Interviewer judgement	MCR
7106	CD radio	0.11	Interviewer judgement	MCR
7108	Audio system	0.29	Interviewer judgement	MCR
7111	Video camera	0.18	Interviewer judgement	MCR
7112	TV, large	5.55	Interviewer judgement	MCR
7115	DVD player	0.85	Interviewer judgement	MCR
7117	Home cinema system	0.32	Interviewer judgement	MCR
7118	MP3 player	0.64	Interviewer judgement	MCR
7119	Game console	0.54	Central staff judgement	MCR
7206	Digital camera	1.63	Interviewer judgement	MCR
7713	Computer	5.24	MCR	MCR
7719	Computer peripherals	1.75	MCR	MCR
	High-tech products	**22.67**		
5403	Plate	0.69	Interviewer judgement	Direct comparison
5404	Coffee cup	0.74	Interviewer judgement	Direct comparison
5405	Glass	0.67	Interviewer judgement	Direct comparison
5407	Eating knife	0.34	Interviewer judgement	Direct comparison
5408	Saucepan	1.06	Interviewer judgement	Direct comparison
5416	Kitchen knife	1.06	Interviewer judgement	Direct comparison
5518	Kitchen scale	1.06	Interviewer judgement	Direct comparison
5530	Plastic food container	1.06	Interviewer judgement	Direct comparison
5531	Salad bowl	1.06	Interviewer judgement	Direct comparison
	Household equipment	**7.74**		
5304	Vacuum cleaner	0.40	Interviewer judgement	Direct comparison
5313	Microwave oven	1.20	Interviewer judgement	Direct comparison
5314	Coffee maker	1.73	Interviewer judgement	Direct comparison
5315	Water boiler	0.33	Interviewer judgement	Direct comparison
	Household goods	**3.66**		
5507	Laundry service	0.86	Direct comparison	Direct comparison
	Household maintenance	**0.86**		
5203	Towel	0.41	Interviewer judgement	Direct comparison
5204	Duvet cover set	1.15	Interviewer judgement	Direct comparison
5205	Curtain (cloth)	2.89	Interviewer judgement	Direct comparison
5212	Quilt	1.19	Interviewer judgement	Direct comparison
	Household textiles	**5.64**		

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Product group Code	Name	Weight, ‰	Current QA method	Suggested QA method
9604	Hotel weekday	2.23	Direct comparison	Direct comparison
9605	Hotel weekend	2.99	Direct comparison	Direct comparison
	Lodging	**5.22**		
7109	DVD-R	0.35	Direct comparison	Direct comparison
7201	Colour negative film	0.17	Direct comparison	Direct comparison
7304	Music CD	2.39	Direct comparison	Direct comparison
7307	DVD movie	0.90	Direct comparison	Direct comparison
	Media for music, photo and film	**3.81**		
7906	Greeting card	1.02	Direct comparison	Direct comparison
7907	Colour inkjet cartridge	0.27	Interviewer judgement	Direct comparison
9313	Paper notebook	0.60	Interviewer judgement	Direct comparison
	Office equipment	**1.89**		
9114	Eyeglasses	3.14	Interviewer judgement	Direct comparison
9115	Contact lenses	0.50	Interviewer judgement	Direct comparison
	Optics	**3.64**		
9303	Watch	1.67	Interviewer judgement	Direct comparison
9305	Jewellery	2.12	Direct comparison	Direct comparison
9306	Baby carriage	0.31	Interviewer judgement	Direct comparison
9318	Bag, case, purse	1.92	Interviewer judgement	Direct comparison
9319	Jewellery repair	0.05	Direct comparison	Direct comparison
9320	Baby car seat	0.32	Interviewer judgement	Direct comparison
	Other personal goods	**6.39**		
9215	Perm	5.38	Direct comparison	Direct comparison
9216	Electric razor	0.55	Interviewer judgement	Direct comparison
9225	Cosmetics	2.54	Interviewer judgement	Direct comparison
9226	Haircut	9.63	Direct comparison	Direct comparison
	Personal hygiene	**18.10**		
7801	Film developing	0.40	Direct comparison	Direct comparison
7809	Movie rental	1.17	Direct comparison	Direct comparison
	Recreational and cultural services	**1.57**		
6102	Bicycle	1.61	Interviewer judgement	Direct comparison
7305	Musical instrument	0.77	Interviewer judgement	Direct comparison
7415	Flower, plant	4.97	Direct comparison	Direct comparison
7506	Ski equipment	0.81	Interviewer judgement	Direct comparison
7512	Sport equipment	3.15	Interviewer judgement	Direct comparison
7513	Outdoor recreation equipment	1.37	Interviewer judgement	Direct comparison
7601	Toy	4.85	Interviewer judgement	Direct comparison
7607	TV and computer games	2.27	Direct comparison	Direct comparison
7720	Dog vaccination	1.81	Direct comparison	Direct comparison
7721	Flower pot	0.40	Direct comparison	Direct comparison
7723	Pets	0.16	Direct comparison	Direct comparison
	Recreational goods	**22.17**		
9401	Red wine	2.00	Direct comparison	Direct comparison
9403	Beer 4.5-5.6 % alcohol	3.27	Direct comparison	Direct comparison
9405	Schnapps	1.69	Direct comparison	Direct comparison
9406	Beer 3.5-4.5 % alcohol	0.45	Direct comparison	Direct comparison
9407	Beer 2.25-3.5 % alcohol, cafeteria	0.12	Direct comparison	Direct comparison
9502	Soft drink	2.02	Direct comparison	Direct comparison
9509	Dinner	4.39	Direct comparison	Direct comparison
9519	Lunch, restaurant	22.30	Interviewer judgement	Direct comparison
9520	Lunch a la carte, restaurant	3.93	Direct comparison	Direct comparison
9521	A cup of coffee, restaurant	1.42	Direct comparison	Direct comparison
9552	Pizza	3.77	Direct comparison	Direct comparison
9554	Fast food	1.21	Direct comparison	Direct comparison
9555	Pastries, restaurant	1.42	Direct comparison	Direct comparison

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Product group				
Code	**Name**	**Weight, ‰**	**Current QA method**	**Suggested QA method**
9559	Lunch, cafeteria	2.45	Interviewer judgement	Direct comparison
9560	Lunch a la carte, cafeteria	0.43	Direct comparison	Direct comparison
9561	A cup of coffee, cafeteria	0.42	Direct comparison	Direct comparison
	Restaurants	**51.29**		
5410	Hammer	1.43	Interviewer judgement	Direct comparison
5413	Garden spade	0.53	Interviewer judgement	Direct comparison
5426	Lawn mower	1.37	Interviewer judgement	Direct comparison
7709	Drill	0.70	Interviewer judgement	Direct comparison
	Tools and garden equipment	**4.03**		
	Total	**189.09**		