Televisions: Quality changes and scanner data

Prepared for the Ottawa Group meeting in Washington, D.C., April 22-24, 1998

Robin Lowe,
Prices Division, Statistics Canada[1]

Introduction

The purpose of this paper is to examine some of the problems in the construction of price indexes for televisions using our current procedures and also electronic data records[2] that have recently become available. Recent research[3] has documented some of the costs and benefits in the use of scanner data for food items. However, because of product diversity and higher product turnover in the marketplace these costs and benefits may be quite different for consumer durables such as televisions. (Silver et al, 1995,1997.)

The current practice at Statistics Canada consists of collecting prices for a small number of representative items that are monitored over time for changes in price and in quality. When a quality change does occur, it usually signals an item replacement that requires some kind of adjustment. This is where one of the weaknesses of scanner data lies, as the larger number of records may preclude us from giving the same level of care to the quality adjustment process. The critical issue then becomes one of weighing the advantages of additional observations provided by the scanner data against the disadvantages resulting from less close attention to changes in the quality of the sampled items.

What follows is an analysis of the price indexes that were calculated for televisions using the two different approaches -- the current practice and the use of scanner data. The first part of the paper will describe the sample and the operation of quality change evaluation for televisions over the last seven years. An assessment of its impact is also given. Secondly, the results of scanner data for the period February 1997 to February 1998 are presented and examined. Some comparisons are made with the results for the overlapping period from the existing survey and the reasons for the differences are analysed. A number of issues and questions raised in the paper are discussed in the conclusion. The paper finds that the way quality change is handled is important both in the current practice and in treating scanner data. There are other issues concerning aggregation and sample selection that affect the results from the scanner data. However, the impact of making different choices in dealing with the scanner data is less than the difference between the results from the scanner data, and from the regular procedures for that period in 1997 where both sets of data are available.

[1] Thanks are due to Candace Ruscher for performing much of the research, and to John Mallon and Hugh Scobie for programming and carrying out the calculations under different scenarios.

[2] For simplicity electronic data records will be called scanner data in the rest of the paper.

[3] See Reinsdorf, Dalén, Hawkes, de Haan and Opperdoes, Scobie.

CPI index construction for televisions

Televisions exhibit relatively uncommon price behaviour, as their prices have fallen steadily, both in nominal terms and as measured in a price index. The available data set runs from June 1990 through November 1997. There are two representative commodities: a 20" and a 25" to 27" colour set. Deviations from the preferred specification are allowed, for example to allow 19" screen sizes in the first representative commodity, and from 25"to 28"in the second. Since the most common sizes are 20" and 27" they will be labelled thus in the rest of the paper.

Over the study period, the total Canada sample averaged about 220 observations until early 1995, when it dropped to about 140. Altogether there were 337[4] streams of monthly observations, 89 of which continued throughout the whole period. The others entered and/or exited the sample at various times. The 89 streams that were in the sample for the whole period had 579 quality changes, averaging about one a year, though the number of changes ranged from two to twelve. The other observation streams appear to have had quality changes at about the same rate.

Most changes in the sample have been involuntary. Apart from the sample cut in 1995 for budgetary reasons, deletions from the sample and their subsequent replacement were usually made necessary because the retail outlet became unavailable. Occasionally, new outlets were introduced to replace others that were dropped from the sample. Quality change adjustments were also forced, either because the existing item became unavailable, or after being advised that it would soon be replaced. No changes to the item selection were initiated during the study period.

Additions to the sample are routinely treated by bringing them into the month-to-month matched sample without affecting the index level. However, the index measurement can be affected by the judgement made at the time of a perceived quality change. In total, 1213 quality changes were recorded between June 1990 and November 1997. Of these, 664 (54.7%) were splices[5]; this includes 229 cases when neither price nor quality, nor therefore, the index changed. Some of these 229 may have been entries to correct descriptions on the specification, or something equally inconsequential, but it is not possible now to identify them.

There are several patterns of quality change adjustment. We distinguish between small and large changes – that is between cases where the price of the replacement item is within 10% of the replaced item, and where it is not. The choice of 10% is arbitrary; it is chosen to separate what may be just small modifications to essentially the same product from cases where one completely different product replaces another. We distinguish splices from other types of judgement.[6]

---

[4] An observation stream is one series of observations over time, adjusted for quality change if necessary. It begins with an addition to the sample and end with a deletion from the sample

[5] The word splice is used in this paper to describe the situation where the ratio of the price of the replacing item in the *current* month to the price of the replaced item in the *preceding* month is taken to represent their relative qualities. This is different from a true splice, which is based on a comparison of prices at the same time. The additional implicit assumption is that prices have not changed between the two months, which may not be correct; as televisions are not priced every month, the previous month's price may be imputed from an earlier period, which makes this assumption more dubious.

[6] This is not to imply that splices are not judgements. The label "judgement" may be read as shorthand for judging that, in a given case, market prices do not reflect quality differences.

Within judgements, we distinguish between those cases where the quality change is assessed at zero, and those where it is not. Finally, for a subset of cases, from 1993 onwards, where there is some description of the items, we can distinguish between cases where the new item replaces an existing one from the same manufacturer and those where it replaces an item from a different manufacturer. The results of this analysis are shown in the appendix tables, while the summaries are given below.

Summary of Appendix tables:
Of the 1213 quality changes, 732 are small, less than 10% change in price. Of the 481 larger changes, 233 involved replacing the existing item with a cheaper one, and 248 with a more expensive one.

Except for those 229 cases where nothing changed, splicing is much more prevalent where the change is large than where it is small. In only about 37.5% of cases where there was a small price change was it spliced, as opposed to about 55% for large price changes.

Where judgements are used, there is the same association between the price difference and the resulting index difference as has been found generally (Lowe, 1997). That is, particularly for price changes over 10%, the larger the difference in price between the replacing item and the item it replaces, the larger is the impact on the index. This applies downwards as well as upwards – cases where the price drops 20% show the index dropping more than cases where the price drops 10%. The number of large price increases is slightly higher than the number of large price drops.

It is noticeable that in a large number of the judgement changes, (245 of 549), the quality was not deemed to have changed at all. These cases are concentrated overwhelmingly among the small changes where they account for 71% of both upward and downward adjustments.

Of the 750 quality changes since the beginning of 1993 there is some description of the items. There were 552 cases where the change involved replacing an item with another from the same manufacturer, and 198 where the change involved a change of manufacturer. There were striking differences between them. Splicing was much more common (68%) when there was a change in the manufacturer, than when there was not (50%). To some extent difference was due to the higher proportion of large price changes when the manufacturer changed, (59%) than when it did not, (25%). As seen earlier, splicing is more common with large price changes. Splicing, however, was still more common for changed manufacturers right across the board. Similarly, quality is less likely to be judged to be unchanged when the manufacturer has changed.

Treating quality change in the field:
These patterns coincide with the experience of price evaluators. In most cases they have manufacturers' brochures to help them assess changes in the specifications of models. The large number of splices where there is no price change is due to a common practice of manufacturers changing a model number with a new production run, though nothing physically has changed. That also explains a large number of the cases when the quality did not change, but the price and index went up or down slightly. These cases should not really be regarded as quality changes.

Many times a small change in a specification accompanies a model change -- in the type of remote control supplied, in warranty coverage, or in the number or placement of jacks. In these cases the small adjustment in price can be easily calculated; also, the price collector is not really making a change to the sample, it is just a slight modification to essentially the same model.

In other cases when one item is replaced by another, the price collector is asked to find a similar model if possible, but one that is a volume seller. The volume seller requirement sometimes results in a model that is quite different from the previous one. Price evaluators do have adjustment guidelines for different model sizes, from mono sound to stereo sound, and for other common changes, so they can make reasonable comparisons in many cases. However, the comparison is more difficult when it involves a change of manufacturer. It is recognised that manufacturers do vary in quality but it is difficult to compare by how much. That may be why more quality changes are spliced when it includes a change in manufacturer. This is a phenomenon particular to certain retail outlets. Most retailers carry certain manufacturers and change rarely; some, however, will switch frequently, making the best buys they can each time.

Some changes that appear to be judgement changes disguise a different assessment. If the replaced item had been discounted in previous months, the quality and price of the replacement item will be compared to the replaced item at its normal market price, not to the discounted one. If the desired result from that comparison is a splice, the new reference price will be calculated to restore the index movement. Thus, there will appear to be both a quality and an index change. The true number of judgements therefore is smaller than it appears.

Given this careful, conservative programme of quality assessment, the question arises, what is its impact on the index, and what would be the result if different treatments were used? We have recalculated the index numbers for the period using a number of scenarios reflecting different treatments of quality change.

Applying different assessments of quality change:
The first scenario was to replicate current practice.[7] The second scenario was to splice all quality changes, an option that is easy to adopt, and which underlies some uses of scanner data. The third scenario was to splice large price changes only, but to keep the existing results for small changes. The fourth scenario was the reverse of the third – adjustments for large price changes were kept, but small changes were spliced. The purpose of scenarios 3 and 4 was to see the relative impacts of large and small changes on the index. The fifth scenario, a simplistic one, calculated the index with all quality changes ignored and all price changes accepted as pure price change. Finally, there is a variant, scenario 1a, which does not reflect an alternate method of assessing quality changes, but a different computational handling of splices. In this scenario, spliced quality changes are excluded from the matched sample for the month in which the quality change occurs.

[7] This does not recreate the historical indexes exactly, for a number of reasons, including that the regional strata were simplified for these calculations.

Separate results are shown in Table 1 for both common sizes of televisions, and for the two combined, for the whole period. A large part of the drop in prices occurred between 1990 and 1992. These prices are exclusive of retail sales taxes, so the replacement of the manufacturers' sales tax by the Goods and Services Tax probably accounted for some of this drop.

Table 1: Percentage change in index, Canada, June 1990 to November 1997			
Scenario	All TVs	20" TV	27" TV
1: -- Current practice	-23.6	-20.5	-27.3
2: -- All changes spliced	-20.7	-18.6	-23.3
3. -- Large changes spliced	-21.7	-19.1	-24.8
4. -- Small changes spliced	-22.6	-19.9	-25.9
5. -- All changes treated as price changes	-23.5	-20.2	-27.6
1a. - Current practice, most splices excluded[8].	*-24.5*	*-21.5*	*-28.2*

Three things are apparent in Table 1. First, however treated, 20" TVs have fallen substantially less in price than 27" sets. Furthermore, the difference in price behaviour between the two models is greater than the range of results obtained from different treatments of quality change. This suggests that making sure the sample selection is representative is more important in this case than choosing the best quality adjustment technique.

Second, the range of results from different treatments is small compared to the price movement. This is confirmed indirectly by the behaviour of the 89 streams of observations that were in the sample for the whole period. By far the greatest amount of price change, about five-sixths, occurred in months where there was no quality change. To some extent this is due to the low inflation during this period. There were a similar number of downward replacements as upward ones, so their impacts tended to cancel out. Nevertheless, it is interesting to note that if the replacements reflect market changes, many people traded up to more high priced items, instead of benefiting from lower prices.

The largest difference among the scenarios 1 to 5 is between current practice, scenario 1, and scenario 2, splicing all changes. This difference, for all televisions together, is 2.9%. If we regard splicing as the default treatment we see that the impact of applying other judgements was to lower the index by another 2.9%. The impact of the judgements on large price changes was about twice as much (1.9%) as applying it to small changes (1.0%), even though splicing was more common for large changes. It is clear from looking at the patterns of quality change adjustment in the appendix tables that the net impact of assessing small price changes was to lower the index, but it was not obvious that the judgements on the larger changes would have more impact. There were approximately equal numbers of upward and downward adjustments, and one must wonder how many of the splices on large changes should be replaced by judgements.

[8] Those cases where the price and quality did not change were not regarded as quality changes, so were not taken out of the sample for the calculation.

It is curious that the simplistic approach, scenario 5, produces a result close to the actual index. That it is so close is an accident of the time period. The index under scenario 5 falls sharply compared to the regular index (scenario 1) between 1990 and the end of 1991, and rises compared to it from the end of 1995. These periods correspond to the periods of greatest weakness and consumer recovery in the Canadian economy, and the result is consistent with consumers trading down, then up, accordingly. This does provide some validation of the changes in item selection that have occurred over the period, despite the limitations imposed by the specifications.

Third, keeping the spliced observation in the matched sample in the month it is spliced has a relatively significant impact. The impact is about one-third the impact that applying judgements rather than just splicing has. Scenario 1a shows that the drag on indexes by splicing was about 1% over the period, while the impact of quality adjustment was almost 3%. As prices were falling for this commodity splicing has kept the index higher. Preliminary testing on other commodities suggests this may be a general result, particularly for durable goods whose prices are tending to decline.

Calculations based on scanner data

A large retailer, with many stores across Canada, provided the data used for these calculations. The data contain the number sold and average price for each identified product code by month, and by store. The price is the actual transaction price before taxes. Data for stores were aggregated to create one average price and one quantity for each code for each month. Thus some averaging of prices has been done over time and over outlets. The codes distinguish models to approximately the same level of detail as our survey – for example a new production run under a different model number will carry a different code in this database. The number of codes reporting sales in any month is about 200. The company carries only a few manufacturers, but a full range of products from those manufacturers. The code description provides enough information to identify the make and model, so by using brochures or manufacturers, the characteristics of each can be obtained. That has not been done yet; however, the description routinely includes the screen size, which has been useful in distinguishing subsets of the range of models.

The range of products comprises five groups: 20” (19” to 21”); 27” (25” to 29”); 32/35” (31”to 36”); and 13” (including 9”); conventional televisions, and larger screen projection televisions. Indexes are calculated for these specifications separately and grouped together.

It would be useful, in handling the data, to trim it of insignificant and unreliable records. As usual, most of the revenue is concentrated in relatively few products, though the concentration curve is flatter than for some products – the best selling product only accounted for about 8% of sales usually, and there were rarely more than two with even 5% of the total revenue. Over the whole thirteen months 93 product codes accounted for 80% of total sales.

If the data are to be used for index production we need criteria to determine what data should be accepted in the current month. As a first step we considered only those codes that contributed to the top 80% of sales in each month, and calculated monthly estimates on matched data. The results of the chained series over the twelve monthly comparisons from February 1997 to February 1998 are given for a variety of formulae in Table 2.

Table 2: February 1998 index, (Feb 1997=100), chaining monthly matched samples, for products accounting for 80% of each monthly total sale.

					Details within "All other"		
	All	20"	27"	All other	32/35"	13"	Proj. TV
Laspeyres	94.7	98.9	94.8	90.2	87.8	103.6	87.2
Paasche	91.7	95.9	89.9	89.6	89.1	98.4	88.1
Fisher	93.2	97.4	92.3	89.9	88.5	100.9	87.6
Tornqvist	93.1	97.5	92.4	89.8	88.4	101.0	87.9
Geometric(base-weighted)	94.2	98.6	94.3	89.5	87.3	103.2	86.7
Geometric (current-weighted)	92.3	96.3	90.4	90.3	89.7	98.8	88.6

Most patterns are as expected. The base-weighted indexes are higher than the current- weighted ones, except for the large conventional televisions and projection TVs. The Fisher and Tornqvist indexes are almost identical. The 27" set declined in price more than the 20" as it did in the CPI survey. But the most noticeable result is that all indexes show a substantial decline while the orthodox indexes rose slightly between February and November 1997. Indeed, the differences are starker, as the scanner indexes all rose in early 1998. How do we account for these differences? Some possible explanations are examined below.

1. **Items, those listed as "all other", included in this database, are not included in the CPI indexes. They have fallen most**.

This is true, but the indexes for 20"and 27"separately are also significantly lower than in the CPI regular survey.

2. **There was a shift in 1997 towards the higher priced products, the largest TVs and projection televisions. The monthly-chained index reflects the substitution between representative commodities that the CPI index does not**.

This shift is shown in Table 3.

Table 3: Percentage distribution of revenue, by product class, February. 1997 to February 1998

	20"	27"	32/35"	13"	Proj. TV	Other*
February to May 97	21.4	44.3	18.3	7.2	8.3	0.4
June to August 97	20.2	40.3	24.4	8.0	6.8	0.3
September to November 97	16.7	42.5	24.2	6.3	9.8	0.5
December 97 to February 98	14.8	36.1	27.3	5.7	14.2	1.9

(* The main sales under this category were screens for projection televisions.)

As the data are only for one year we cannot be sure that these are not just seasonal variations. However, comparison of the distributions for February 1997 and February 1998 shows a similar shift.

However, this explanation does not work empirically. Taking the five product groups' indexes separately and weighting them with the first four months' pattern, the Fisher indexes produce an overall index of 91.8 instead of 93.2 and Tornqvist gives 94.2 instead of 94.0

The reason for this has to do with how representative the scanner sample is. As it was restricted to a subset of the top 80% of total sales a higher proportion of 20"and 27" televisions got included. Projection televisions in particular are represented by a wide spread of models, few of which often had sufficient weight to be counted among the top 80%. On average over the year, 72% of sales of 20" TVs, and 83% of sales of 27" TVs are included in the matched samples. For the other groups the percentages are 69% for 32/35" TVs, 60% for 13" TVs and 46% for projection TVs. For both the 32/35" models and projection TVs the representation was lowest early in the period when prices were falling fastest. So although the chaining reflected the shifting retail patterns, the larger televisions were routinely under-represented, in what was a self-weighted sample.

3. **The selection criteria produce something akin to the bouncing effect. If a product drops below the 80% of sales level for even one month, it drops out of two months' comparisons. If this drop in sales is due to a relatively high price, that product will be excluded when prices are rising.**

In the calculations this appeared to be a problem. We computed indexes on different criteria under which the condition for initial inclusion in the sample was the same, but once in the sample, a product stayed for as long as it was reporting sales. However, under these conditions the indexes came out virtually the same – Fisher 93.1 instead of 93.2. We believe this is because this criterion keeps old models in the sample longer when their sales are small, but are at greatly discounted prices.

4. **As all new items are linked into the sample there is a ratchet effect if they are introduced at relatively high prices and then the prices are cut. The drop shows up, but not the initial increase.**

This is demonstrated in Table 4, where item two differs from item one only in its model number.

Table 4: Monthly chained index calculations when one model replaces an identical one in the market

	Model 1		Model 2		Indexes (February 1997 =100)			
	Units sold	Average price: $	Units sold	Average price: $	'Laspeyres'	'Paasche'	'Fisher'	Average price
Feb.	91	846			100.0	100.0	100.0	100.0
Mar.	99	850			100.5	100.5	100.5	100.5
Apr	66	850			100.4	100.4	100.4	100.4
May	73	845			99.9	99.9	99.9	99.9
Jun.	68	844			99.8	99.8	99.8	99.8
Jul.	53	828			97.9	97.9	97.9	97.9
Aug.	85	778	15	883	92.0	92.0	92.0	93.8
Sep.	63	732	73	874	87.3	89.1	88.2	95.5
Oct.	17	697	79	863	84.9	87.5	86.2	98.5
Nov.			87	852	83.8	86.4	85.1	100.7
Dec.			114	845	83.2	85.7	84.4	99.9
Jan.			68	884	87.0	89.6	88.3	104.5
Feb.			55	904	88.9	91.7	90.3	106.8

The first three index computations are based on assuming the items are not directly comparable. From February to August 1997 and from October 1997 to February 1998 the movement in the three columns Laspeyres, Paasche and Fisher are identical. That is because there is only one item to be included in a matched sample. Even in August a true Paasche index cannot be calculated, as there was no observed price for item two in July and in November a true Laspeyres index cannot be calculated, as there was no observed price for item one. These three measures only differ between August and October.

The last column in Table 4 is based on recognising that the two codes cover identical items, and indexing the weighted average price each month. The difference is remarkable. It is difficult to see why there should be such a large difference between the prices of the two items in the same stores at the same time. Most sales were made in stores where both models were available, although the price of item two was lower on average than in stores where item one was not available, and the price of item one was higher in stores where item two was not available. If this situation is widespread it clearly has a large downward impact on the index measurement. We know that there are many substitutions of this kind, where the new model is identical to the old, or differs only slightly.

However, it is hard to say what the overall impact of this effect is. It appears that the introduction of the newer model at the higher price -- together with the reductions on the older model in this case -- may have been designed to clear the older one from stock. Other new models, competing with a wider range of alternatives, may not be introduced at an overpriced level. We can make some comparisons with the price movement of the models that remained in the sample over the whole period.

Table 5 shows the results of direct comparisons between February 1997 and February 1998 for those models that were available in both periods.

Table 5: Index (February 1997=100) based on direct comparisons from February 97 to February 98 for available models

	All	20”	27”	32/35”	13”	Proj. TV
Laspeyres	89.3	93.7	88.7	83.3	90.0	84.6
Paasche	91.6	96.1	92.8	81.1	94.1	88.6
Fisher	90.4	94.9	90.7	82.2	92.0	86.6

These results are lower than, usually much lower than, the chained monthly indexes. Of course, at the beginning of the period these may have been recent introductions to the sample, and their prices could have been in the process of falling from initially high levels. We do not know. Furthermore, while the models included account for 75% of sales in February 1997 (90% of 20”and 27” televisions) their share had fallen to 20% by 1998 (nearly 30% for 20”and 27”). It reinforces the necessity to update the sample selection promptly. Nevertheless, these models, whose prices were falling steadily, were available, albeit with a declining share of the market. Prices in the rest of the market could not have been rising relative to this subset unless customers in the market were very uninformed, or put a high premium on novelty.

5. The price behaviour of the company supplying data is not typical of the market as a whole.

We do not know whether the shift to higher priced products in 1997 was experienced generally. We can compare the price behaviour of this company with others in the CPI sample as some of the CPI sample is drawn from this company. Two simple comparisons were made: between the subset of CPI prices from this company and the CPI generally, and between the scanner results for those models selected in the CPI and all models for that size of TV in the scanner data base.

The results for the period February to November 1997 (putting February =100) for TVs are: - CPI data from this company 102.2 for 20" TVs, and 104.1 for 27". The official CPI index for TVs was 101.2, slightly though not significantly lower. For scanner data for those models selected in the CPI, the Fisher indexes were: 98.0 for 20" TVs, (94.9 for all 20" models), and 87.7 for 27" TVs, (88.9 for all 27" models). While there are variations, particularly for the 20" sets, these results do not suggest the selection is particularly unusual.

The other comparison that can be made is to use the scanner prices that match the models selected in the CPI and use the CPI evaluation of quality differences to adjust the prices to a constant quality equivalent. When the models are the same the scanner data for the models are averaged together, as in the example shown in Table 4. When, as happened in one case, a model was replaced by another valued at eight-ninths the quality, the prices of the second model, devalued by one-ninth, are averaged with the first. Using these adjusted values the Fisher index for 27" TVs became 91.3 -- closing about one-sixth of the gap between the scanner and CPI index movements. On the other hand the index for 20" sets became 98.1, virtually unchanged from the unadjusted series. This is, of course, much too small a test for the result to be extrapolated.

Conclusions:

The recitation of the methods and alternatives in treating quality change in the CPI survey demonstrates the limited impact that they have on the index calculation, even compared to the impact of sample selection at the detailed level.

The differences between these indexes and ones obtained from scanner data are striking and difficult to explain. The scanner data have to be managed carefully. There are difficult questions to answer concerning the choice of the subset of data to be included in the calculations, whether to group together different products or to weight together their separate indexes, and how to introduce new items into the calculation.

Of these, the problem of introducing new products into the index may be the most important. It is clear that the assumption underlying any use of matched samples, that relative prices reflect relative qualities, does not hold here. At the very least, replacements that are really continuations of the same product under a different name must be recognised. More generally, the kind of transformation grid for different characteristics, derived from regression analysis described in Silver et al. (1997) should be applied if the characteristics can be obtained quickly enough.[9] However, the few comparisons that have been made using prices of constant quality suggest that the range of impact between doing quality adjustment well or badly is still small compared to the difference between the scanner data and the regular survey results.

The benefits of using scanner data may be greater in this area (compared with foodstuffs for example) because of the wider dispersion of products and the more rapid turnover of models. However, analysis of these data throws some doubt on the assumption that it is not possible to give enough attention to individual scanner data reports. There are ten streams of observations from this company for televisions in the CPI survey. In the first set of matched samples, there are only an average of thirty-five streams of data, which cover a broader range of products (large and smaller TVs and projection TVs). For 20" and 27" TVs there are only an average of twenty streams. This is not a number of a different order of magnitude, and it may be practical to reduce the scanner sample further. Of course, the number of new products introduced which have to be monitored in case they reach the threshold of being introduced, is rather higher. Nevertheless, a possibility may be to combine the constant updating of weighting data and actual transaction prices with the statistical care applied to the evaluation of quality changes.

[9] While there has not yet been time to collect and code the characteristics of models in the scanner data, there is sufficient description on the current CPI sample to test some characteristics. The regression run on November 1995 data produced dummy variables for manufacturers quite similar to Silver's study, viz; (all adjustments referenced to Sony.) Silver: Panasonic .944, Toshiba .931, Hitachi .905, JVC .844, Sharp .834, Sanyo .826, Samsung .786. CPI: Panasonic .909, Hitachi .907, JVC .861, Sharp .812, Toshiba .793, Sanyo .779, (Zenith .773), Samsung .756, (RCA .738). Except for Toshiba, which has few models in the CPI sample, the rankings are identical and the factors are similar.

References:

Dalén, J., (1997) *"Experiments with Swedish scanner data."* Proceedings of the Third Meeting of the International Working Group on Price Indices, pp 163-168, April 16-18,1997, Voorburg, Statistics Netherlands.

de Haan, J. and Opperdoes, E., (1997) *"Estimation of the coffee price index using scanner data: simulation of official practices."* and *"Estimation of the coffee price index using scanner data: the choice of the microindex."* Proceedings of the Third Meeting of the International Working Group on Price Indices, pp 183-202, April 16-18,1997, Voorburg, Statistics Netherlands.

Hawkes, W.J., (1997) *"Reconciliation of consumer price index trends with corresponding trends in average prices for quasi-homogeneous goods using scanner data."* Proceedings of the Third Meeting of the International Working Group on Price Indices, pp 145-162, April 16-18,1997, Voorburg, Statistics Netherlands.

Lowe, R., (1997) *"Item selection and quality change in the Canadian CPI."* Proceedings of the Third Meeting of the International Working Group on Price Indices, pp 275-290, April 16-18,1997, Voorburg, Statistics Netherlands.

Reinsdorf, M., (1996) *"Constructing basic components for the U.S. CPI from scanner data: a test using data on coffee."* Presented at NBER Conference on Productivity, Cambridge, Mass., Working Paper 277, U.S. Bureau of Statistics.

Scobie, H., (1997) *"Use of scanner data – the impact of new goods."* Unpublished paper prepared for meeting of the Price Measurement Advisory Committee, May 1997, Ottawa, Statistics Canada.

Silver, M., (1995) *"Elementary aggregates, micro-indices and scanner data: some issues in the compilation of consumer price indices."* Review of Income and Wealth, Series 41, Number 4, December 1995, Cardiff Business School, University of Wales, College of Cardiff.

Silver, M., Ioannides, C., and Haworth, M., (1997) *"Hedonic quality adjustments for non-comparable items for consumer price indices."* Proceedings of the Third Meeting of the International Working Group on Price Indices, pp 203-214, April 16-18,1997, Voorburg, Statistics Netherlands.

Appendix:

Table I. Distribution of quality changes for televisions July 1990 to November 1997, by ratio of replacement item to replaced item.

Price ratio	Total changes	Non-splices (judgements)	Splices	Percentage of total changes that are spliced	Index ratio for judgements(1)
.5 to .69	15	5	10	66.7	
.7 to .79	65	31	34	52.3	
.8 to .89	153	67	86	56.2	
.9 to .99	271	173	98	36.2	
1	274	45	229	83.6	
1.01 to 1.09	187	114	73	39.0	
1.1 to 1.19	136	64	72	52.9	
1.2 to 1.29	66	32	34	51.5	
1.3 or more	46	18	28	60.9	
All changes	**1213**	**549**	**664**	**54.7**	
Large changes	481	217	264	54.9	
Small changes ex. Ratio = 1	458	287	171	37.3	

(1) This is the average pure price change calculated for those judgement changes whose nominal price change falls into each category. For splices, by definition, it is 1. For judgements, the estimated pure price change rises with the nominal price ratio.

Table II. Distribution of quality changes for televisions, January 1993 to November 1997, by ratio of price of replacing to replaced item, by whether manufacturer (brand) changes with the quality change.

	Brand does not change				Brand changes			
Price ratio	Total changes	Judgements	Splices	%age of total spliced	Total changes	Judgements	Splices	%age of total spliced
.5 to .69	4	1	3	75.0	3	1	2	66.7
.7 to .79	8	3	5	62.5	15	3	12	80.0
.8 to .89	51	25	26	51.0	32	3	29	90.6
.9 to .99	139	98	41	29.5	21	8	13	61.9
1	170	29	141	82.9	28	3	25	89.3
1.01 to 1.09	107	80	27	25.2	32	18	14	43.8
1.1 to 1.19	50	30	20	40.0	24	11	13	54.2
1.2 to 1.29	14	8	6	42.9	19	8	11	57.9
1.3 or more	9	3	6	66.7	24	8	16	66.7
All changes	**552**	**277**	**275**	**49.8**	**198**	**63**	**135**	**68.2**
Large changes	136	70	66	48.5	117	34	83	70.9
Small changes ex. Ratio = 1	246	178	68	27.6	53	26	27	50.9

Splices are more likely when the brand changes. Partly this is because brand changes are more common with large price changes -- major replacements -- but the rate of splicing when the brand changes is higher for every price ratio.

Table III. Distribution of *judgement* quality change assessments for televisions, January 1993 to November 1997, by price ratio, by whether brand changes, and by whether quality is judged to be changed or not.

	Brand does not change				Brand changes			
Price ratio	Total changes	Quality changed	Quality not changed	%age quality unchanged	Total changes	Quality changed	Quality not changed	%age quality unchanged
.5 to .69	1	1	0	0	1	1	0	0.0
.7 to .79	3	3	0	0	3	3	0	0.0
.8 to .89	26	15	11	42.3	3	2	1	33.3
.9 to .99	97	22	75	77.3	8	3	5	62.5
1	29	29	0	0	3	3	0	0.0
1.01 to 1.09	80	15	65	81.3	18	6	12	66.7
1.1 to 1.19	30	25	5	16.7	11	9	2	18.2
1.2 to 1.29	8	6	2	25.0	8	8	0	0.0
1.3 or more	3	3	0	0	8	8	0	0.0
All changes	**277**	**119**	**158**	**57.0**	**63**	**43**	**20**	**31.7**
Large changes	71	53	18	25.4	34	31	3	8.8
Small changes ex. Ratio = 1	177	37	140	79.1	26	9	17	65.4

Again, brand changes occur more often when there are large price changes. Nevertheless, when the brand changes, a replacement item is less likely to be judged of equal quality to the replaced item, whatever the circumstances. Most quality change assessments when the price change is small turn out to have no quality change. Many of these changes probably involve nothing more than a change in the label of the same model – though clearly not when the brand changes.