Quality adjustment and scanner data

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Summary of session

The papers considered under this topic covered a range of issues relating to the adjustment of prices for changes in quality and the use of scanner data in CPI compilation.

It is intended that CPI's measure price change of items of constant quality. However, in reality few items remain exactly the same over time. There are many aspects of quality change. Some quality dimensions of products are readily observable (e.g. volume or weight) and adjustments for changes in these are relatively straightforward. Other changes are less visible and hence are difficult to measure and make adjustments for. In addition, quality change issues arise in the treatment of new and disappearing items.

There are various methods of controlling or adjusting for quality change, including the use of matched samples, simple subjective judgement and hedonic techniques. Sellwood provides a discussion of quality adjustment practices and objectives. For example, he notes that sample replacement (or rotation) of itself is not a quality adjustment procedure although it may produce a different index outcome, while use of overlap prices implicitly assumes that all the price difference is due to quality. Sellwood calls for greater clarity in defining quality and in specifying quality adjustment procedures.

The papers of Bode and Van Dalen, Lee and Okamato and Satou provide examples of estimates of price change using different hedonic approaches for removing quality change.

Matched samples, by definition, maintains items of the same quality in the index but it can result in a loss of market coverage as items change or cease to exist. Frequent sample updating can sustain market coverage, but still needs to be accompanied by suitable methods of quality adjustment. Silver and Heravi utilise scanner data on washing machines to explore the effects of different sample updating/imputation practices and hedonic quality adjustment. Their results indicate the desirability of frequent updating (or rotation) of the samples to maintain item coverage, and the use of hedonic and comparable replacement techniques over implicit imputation.

While there is an extensive range of literature on the hedonic technique, there has been no clear resolution of exactly how it should be used in constructing price indexes. For example there are questions about what functional form should be used or whether regressions should be run over the entire time period (with dummy variables for each time period) or separate regressions for each time period. The papers of Koskimäki and Vartia and Diewert fill an important gap in this area.

Diewert provides an economic formulation for the approach to hedonic quality adjustment starting with an individual consumer and traditional utility theory under a range of assumptions. Koskimäki and Vartia provide a product level presentation. Both papers argue that hedonic regressions should be run separately for each time period using a constant set of quality variables, rather than one regression with time dummies or two period comparisons. Under this formulation the coefficients of the quality variables will change over time reflecting changes in consumers valuations of these attributes. Quality adjusted price changes can then be calculated at the average of the qualities prevailing in each period, rather than the average for the full period covered by the price observations. Both papers argue that the appropriate functional form is one which uses a logarithm of price as the dependent variable,

while Koskimäki and Vartia further argue that the independent variables should also be in logs and encouraged the use of other non-linear forms. Regression forms that are linear in the 'raw' prices and attributes are to be avoided.

Diewert also shows that under certain conditions, if models are matched each period, then the hedonic regression approach will give exactly the same answer as a traditional statistical agency approach to the calculation of an elementary index. He supports other researchers claims that the advantage of the hedonic approach over matched samples increases as the degree of matching decreases. Diewert also argues that quantity weights should be used in hedonic regressions if possible, although in discussions Vartia expected weighting to have little impact on the results.

Bode and Van Dalen's paper could be considered as providing the empirical counterpart to these theoretical considerations. Their preferred model appears to be an annual semilog model, using weights at the level of brands.

Meeting discussions raised various issues in relation to hedonic regressions. While recognising the theoretical advantages of the approach, practical problems such as selecting appropriate quality measures and specifying the functional form were raised. The cost of collecting suitable data and estimating the regressions was also of concern.

The potential of scanner data has been apparent to price statisticians for some time. Most studies to date have focussed on the use of scanner data as a source of price information and a means of evaluating the performance of CPI indexes (eg Richardson). Scanner data is a valuable source of data as it often provides almost total coverage of the market for a particular product. However, scanner data is often not sufficiently 'clean' for direct use by price statisticians in that the product codes do not always change when an item's quality changes, prices may be affected by specials on sales after use by dates, and so forth (e.g. Richardson). There are wider applications for scanner data, such as providing weights for hedonic regressions and as a frame for updating CPI price samples. Fenwick, Ball, Morgan and Silver show how scanner data can provide good insights into the adequacy or otherwise of CPI price samples and by implication the practices used in determining how items and outlets are selected for the sample.

Meeting participants raised concerns about the cost of using scanner data. Some participants expressed views that the cost of using scanner data was at least double that of existing CPI price collection practices and suffered from the reliability issues mentioned above. It was not clear if the potential improvement in the reliability of price indexes warranted the extra cost at this stage.

Recommendations for statistical agencies

1. update price samples as frequently as is possible and reasonable,
2. use matched samples where it is expected that the proportion of matched items will be large (i.e. where new and disappearing goods are expected to account for only a small proportion of items),
3. use hedonic models where new and disappearing goods are likely to account for a significant proportion of items,
4. hedonic regression models should use the logarithm of price as the dependent variable, and preferably also logarithms of the independent variables – regressions that are linear in raw variables are to be avoided,
5. separate hedonic regressions should be run for each time period if practical,

6. quantity weights should be used in hedonic regressions if possible,
7. scanner data looks promising if it covers the universe for items. Scanner data has potential as a method of price collection for various items if improvements are made to the reliability of the data,
8. scanner data has potential to provide other useful information to price statisticians and these deserve further exploration,
9. further study of the cost effectiveness of scanner data is required.