Session 2 - Use of hedonic regressions

Chair: Mick Silver, Cardiff University, UK

Summary of session

This session benefited from two detailed and well-worked papers on the use of hedonic regressions: Jan de Haan on the time dummy approach to hedonic indices and Erwin Diewert on a review of some unresolved issues in estimating hedonic regressions.

Okamoto tabled an empirical paper on weights in hedonic regressions.

Silver tabled a paper on the use of weights in hedonic regression.

The last room document from van der Grient and de Haan compared the time dummy approach and the matched model Törnqvist price index on televisions data.

It is worth distinguishing between two uses of hedonic regressions: their estimation so that imputations can be made for the prices of unmatched, non-comparable replacements and the use of hedonic indices, such as the time dummy variable method (DT) or hedonic imputed indices (HI). The DT is the focus of de Haan‘s paper while Diewert considers issues arising in both application.

The time dummy variable method has much to commend it, especially insofar as its use of all the data in the two periods being sampled. This compares with hedonic imputations under the matched models method for just (non-comparable) replacement items. The paper by de Haan is to be welcomed in its development of tools for product areas where there is a rapid turnover in items. A major development of the paper is the appreciation that since unmatched and matched items may have different (quality-adjusted) prices; this can be explicitly modelled as part of the estimation process. De Haan considers systematic differences between quality-adjusted matched and unmatched prices. It is very important and analytically useful to disentangle such effects, and to bring them into the estimation procedure. This he does.

De Haan advises a double imputation price index as a weighted geometric average of the matched-product geometric mean index and the time dummy index. This method is intuitively appealing since it explicitly restricts hedonic modelling to unmatched products while leaving the price relatives of matched products unaffected. The cleverness of his double imputation approach is use actual comparisons for matched and a ‘tailored’ set of hedonic coefficients using the ‘new’ and ‘old’ coefficients for unmatched. He further incorporates a sampling framework to allow sample estimates of target indices and draws particular attention to a Törnqvist target index.

There is no doubt a contribution in this paper, especially with regard to the need for a more careful specification required for hedonic estimates for unmatched replacements and the impact of sample design on calculated indices. There remains the issue of whether imputations for the whole sample are preferable to imputations for only the unmatched sample using the double imputation method.

De Haan recognises that the time dummy in practice could approximate the hedonic quality adjustment index quite well, but we cannot be sure of this. A possible cause for bias in double imputation comes from the restrictive specification of the hedonic modelling. Indeed the specification for the unmatched assumes the slope coefficients are constant for matched and unmatched. Moreover the instrument used to correct the unmatched items is an estimator born out of the whole sample. Ideally it should be born out of just the unmatched new and just the unmatched old. This would equate with separate regressions with separate slope and intercept variables for the unmatched old and unmatched new. But degrees of freedom problems would probably preclude this. So the unmatched old and new slope coefficients are constrained to be the same and only the intercepts differ. This is a restrictive assumption and its problems must be weighed against the problems of other imputation methods involving both matched and unmatched items for the whole sample using predicted values.

This is however, a possible path to explore and in no way detracts from the contribution of the paper.

Diewert asks five questions:

1. Should separate hedonic regressions be run for each of the comparison periods or should we use the dummy variable adjacent year regression technique?

2. Should regression coefficients be sign restricted or not?

3. Should the dependent variable be transformed or not?

4. Should the hedonic regressions be weighted or unweighted? If they should be weighted, should quantity or expenditure weights be used?

5. How should outliers in the regressions be treated? Can influence analysis be used?

The formal working of these issues is an important contribution, these matters having previously been raised in either pure statistical or discursive terms.

The discussion focussed on two issues, (1) and (4).

(1) Should separate hedonic regressions be run for each of the comparison periods or should we use the dummy variable adjacent year regression technique?

The running of separate hedonic regressions for each of the comparison periods - base and current periods – to give rise to hedonic imputed indices (HI) based on such regressions is one approach.

$$P_{HB-GMB} = \frac{\left[\prod_{i=1}^{N} h_i^t\left(z_i^0\right)\right]^{s_i^0}}{\left[\prod_{i=1}^{N} h_i^0\left(z_i^0\right)\right]^{s_i^0}} \qquad P_{HC-GMC} = \frac{\left[\prod_{i=1}^{N} h_i^t\left(z_i^t\right)\right]^{s_i^t}}{\left[\prod_{i=1}^{N} h_i^0\left(z_i^t\right)\right]^{s_i^t}}$$

$$P_{HBC-Tornq} = \sqrt{P_{HB-GMB} P_{HC-GMC}}$$

The dummy time (DT) variable adjacent year regression technique is another.

$$\ln p_i^t = \beta_0 + \beta_1 D^t + \sum_{k=2}^{K} \beta_k z_{ki}^t + \varepsilon_i^t$$

Diewert argues that a disadvantage of HI is that two estimates result. But this is simply the spread arising from the change between the base and current period characteristic being compared. We do not express concern that a Fisher index arises from two different estimates - Laspeyres and Paasche. We would prefer the spread to be minimal but when it is not be we do not abandon Fisher. The two estimates or separate bounds provide interesting information
Diewert also argues that DT in constraining the coefficients to be the same in the periods compared has more degrees of freedom than HI. But HI are more flexible in that the implicit functional form, a geo mean of two estimates, allows variation in slope coefficients unlike DT. So it may conserve degrees of freedom, but at a cost. Diewert finally argues that DT is less subject to multicollinearity. However, the use of predicted values for hedonic indices, rather than individual coefficients, negates some of the disadvantages of multicollinearity.

The second issue discussed was weighting.

(4) Should the hedonic regressions be weighted or unweighted? If they should be weighted, should quantity or expenditure weights be used?

Diewert argued well for the use of weights, using a WLS estimator. Some weights are better than none. The question was whether quantity or expenditure based ones were best.

Okamoto in a tabled paper undertook an extensive study for TVs. He found different weights can matter. Disparities were less so if (higher priced) wide screen (WS) sets excluded.

Diewert argued, on the basis of representativity, that quantity weights gave too little weight to high priced items for the decomposition of value changes. He argued that value weights were preferred, and for dummy variable time, value shares for homoskedastic residuals.

Silver in a tabled paper showed that OLS and WLS weights need not be representative due to influence of observations. He suggested deletions of low weighted observations with undue influence. Concern was expressed over the deletion of information.

Some participants argued that while there was a case for representative weights for hedonic DT indices, they need not be required for hedonic estimates used to correct for quality non-comparable replacements. The case was made that either the sampling of items implicitly weighted the regression. And furthermore, if all observations are in hedonic competitive equilibrium the equal weighting would not be biased. This remains an empirical matter.

Other points raised by Diewert were accepted.

Recommendations for statistical agencies

1. When using imputations for non-comparable items by predicting their prices from a hedonic regression there is a case for including dummy variables in the regression on whether the item is 'unmatched new' as well as 'unmatched old'. The double imputation framework outlined in de Haan can then be used to more appropriately make such adjustments.

2. When using DT indices some weighting is better than no weighting and value share weights seem slightly preferable to quantity weights on grounds of representativity.

3. When using hedonic regressions for estimating prices for non-comparable replacements unweighted estimates may be suitable if an appropriate sampling scheme is used or the market is in competitive hedonic equilibrium.

4. It seems preferable to use the log of the price for the dependent variable rather than the model price itself.

5. Sign restricting the estimating coefficients on the basis of theory/a priori expectations is recommended as a careful practice to help provide interpretable results.

6. Some value was found in the use of influence analysis for representativity, but caution was expressed over any undue deletion of observations with high influence unless their weights were low.