Comment on David Melser's paper entitled:

The Hedonic Regression Time-Dummy Method and the Monotonicity Axioms

1. Preliminary Remarks

The reliability of the findings derived from a hedonic regression analysis depends on – among other things – the quality of the data source. Sometimes, scanner data provide such data. Suppose, for example, that T periods are analysed and that the relationship between the products' prices and qualitative characteristics in each time period t is given by

$$\ln p_i^t = \beta_0^t + \sum_{k=1}^{K} \beta_k^t q_{ki} + u_i^t \,, \qquad t = 1, 2, \ldots, T \,. \tag{1}$$

The dependent variable in this equation, $\ln p_i^t$, is the natural logarithm of the observed price of model i during time period t. The qualitative characteristics of model i are represented by the K variables, q_{ki} $(k = 1, 2, \ldots, K)$. The intercept term β_0^t can be interpreted as measuring those factors in the marketplace that determine the logarithmic price of model i other than the model's own inherent product quality features. The K slope coefficients, β_k^t $(k = 1, 2, \ldots, K)$, on the other hand, can be interpreted as the semi-elasticities of a product's price with respect to the k^{th} qualitative characteristic. The stochastic variable u_i^t is a random error term.

If the utilized data source provides sufficient information, then each of the T hedonic equations represented by (1) can be separately estimated. However, when long term retrospective hedonic regression analysis is conducted, then the amount of available information is often quite limited. What type of hedonic regression technique should be used, when there is a lack of data? In that case, different hedonic regression techniques could be applied. Which of these alternative methods is the most appropriate? One criterion could be: Does this method satisfy the monotonicity axiom? This is the primary motivation behind David Melser's paper. The author offers monotonicity as a criterion for selecting a good hedonic regression technique. The paper is very well written and provides a careful analysis of the underlying forces that drive the author's findings. The author's finding is surprising as well as interesting.

2. Alternative Hedonic Regression Techniques

With insufficient data, a useful estimation technique that has been recently proposed is the CCC method (continuously changing coefficient method). The details of this method are spelled out in Auer (2004). The basic idea of this method is simple and

not new in econometrics: The CCC method applies polynomials for approximating the time series of β_k^t.

As an alternative to the CCC method one may apply the TDV method introduced by Court (1939). In its simplest form, the TDV method estimates the hedonic equation

$$\ln p_i^t = \beta_0 + \sum_{s=2}^{T} \gamma^s d_i^s + \sum_{k=1}^{K} \beta_k q_{ki} + u_i^t \ , \tag{2}$$

with

$$d_i^s = \begin{cases} 0 & \text{if model } i \text{ is not observed in year } s \\ 1 & \text{if model } i \text{ is observed in year } s \ . \end{cases}$$

The estimated coefficient $\hat{\gamma}^s$ approximately measures the overall percentage price change between year $t = s$ and $t = 1$.

The author's paper provides a critical assessment of the TDV method. The author regards monotonicity as a criterion for differentiating between suitable and unsuitable hedonic regression techniques. In the paper it is shown that the TDV method violates this axiom. The author concludes that one should rather rely on an alternative hedonic method. The author proposes the *generalised dummy variable method* developed by Diewert (2001). It is a major problem of this method that it requires a rich data source.

3. Monotonicity as a Criterion for Selecting a Good Hedonic Estimation Technique

Is the violation of monotonicity a strong argument against the TDV method? As described in Auer and Brennan (2004), the TDV method exhibits some serious shortcomings. However, it is doubtful that the violation of monotonicity can be considered as such a shortcoming. The doubts can be most easily illustrated by using an analogy. Suppose that instead of the "suitability of hedonic regression techniques" the "knowledge and ability of university students" is to be screened and that instead of "monotonicity" the criterion is "pass or failure in the written exam". Of course, if the exam were such that even the most talented and best prepared students fail the exam (e.g., because the exam questions are unclear or completely different from what the students were asked to prepare), then this exam would be a rather useless criterion for differentiating between good and bad students. Similarly, if the TDV method failed monotonicity even though the TDV method is the "best estimation technique", then monotonicity would be a doubtful criterion.

What is meant by "best estimation technique"? If equation (2) *were* the true relationship (a hypothetical situation that is a standard tool for gaining insights into statistical and econometric theory) between prices and qualitative characteristics, then no other equation than equation (2) should be estimated and under the usual conditions the ordinary least squares method would be the efficient estimation technique (best linear unbiased estimator). For this hypothetical case one could regard the TDV method as the "best estimation technique". The monotonicity axiom

would lose its appeal as a criterion for selecting appropriate hedonic regression techniques, if even in this hypothetical case the TDV method failed monotonicity (just as the exam loses its appeal, if even the best students fail the exam). However, as shown by the author, the TDV method violates monotonicity regardless of whether one has a situation where this estimation technique is the best estimation technique or not.

What can be said about the case where equation (2) does not describe the true relationship? Then estimating this equation (TDV method) is inappropriate anyway, regardless of whether the TDV method violates monotonicity or not.

In sum, the violation of monotonicity is a collateral problem of the fact that in hedonic regressions parameters have to be estimated. It is a valuable contribution of the author, to bring this problem to our attention. However, monotonicity is less convincing as a criterion for selecting a suitable hedonic regression technique.

Are there other axioms that could be used as criterions for the appropriateness of hedonic regression techniques? Most of the standard axioms do not make sense in the context of indices that are estimated from hedonic regression techniques. This is due to the fact that in hedonic regressions the number of goods changes over time. An axiom that makes sense, even in the case of a varying number of goods, is *linear homogeneity*. The TDV method seems to satisfy this axiom. But for the same reasons as outlined above, it is doubtful whether this should be regarded as a signal in favour of the TDV method.

References

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July 20, 2004

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