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Market Values of Environmental Amenities: A Latent Variable Approach

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This study presents a latent variable framework to provide consistent and efficient estimates of market values of amenities. A model for property values of residential housing using different indicators for neighborhood quality and property value is estimated using data from the U.S. American Housing Survey. The estimated effect of neighborhood quality on property values is positive and more significant compared to the estimates obtained by ordinary least squares and instrumental variable methods. Variances of errors of measurement and variances of the latent structures are shown to be positive and significant without imposing nonnegativity restrictions.

Key Words: environmental amenities; multiple indicators; structural equations; neighborhood quality.

1. INTRODUCTION

The issue of measurement of environmental improvements has important policy implications, as has been pointed out, for instance, in Bartik and Smith (1987), Baumol and Oates (1988), Smith (1990), and more recently in Cropper and Oates (1992). Adequate measures of the demand for environmental quality provide an indication of the dollar value placed on the benefits of environmental programs. Smith (1990) presents a good description of the problem facing the analyst who needs to measure implicit price values that individuals impute when they consume services provided by environmental amenities.

In this paper we use samples obtained from the American Housing Survey (AHS) to estimate the effect of *neighborhood quality* on housing prices. There

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are two major approaches to valuing site amenities: the hedonic framework and discrete choice models. We use the hedonic approach to impute the value of environmental amenities. The basic idea of the hedonic approach is to view goods as different bundles of homogeneous attributes or characteristics. Thus, the demand for a good becomes a demand for the attributes it contains (Gorman (1980), Griliches (1974), Lancaster (1966, 1971), Rosen (1974)). The advantage of the hedonic approach is that it simplifies the analysis of complex market structures, where many differentiated products interact, into a simpler analysis of a smaller number of homogeneous attributes.

Although the hedonic approach to impute the value of site amenities has many attractive features, it also suffers from a major drawback, namely, the lack of a uniformly accepted measure of neighborhood quality. Goodman (1986) considers neighborhood quality to be related to attributes or characteristics of (1) the environment, (2) socioeconomic conditions, (3) quality of public services, and (4) location. Others have included variables such as crime rate and recreational opportunities in their regressions of price on attributes (e.g., Witte *et al.* (1979), Dubin and Sung (1990)). However, these measures may be used because of their availability rather than their reflection of consumers' perception of the amenity. If these variables are imperfect measures of consumers' perceptions of amenities, their use can lead to misspecification of the hedonic equation. If they are used as proxy variables for latent amenities, their use raises the familiar measurement errors issue. The presence of either or both of these shortcomings can lead to biased and inconsistent estimates of the environmental impact on housing prices as well as other coefficients of the model.

In this paper we propose a latent variable framework to take account of both the issue of measurement errors and the lack of consensus about what is the best measure of environmental amenity or how many of these measures to use. The latent variables approach allows the analyst to use multiple measures of quality to build a composite measure based on different observed attributes while explicitly taking into account measurement errors and avoiding troublesome multicollinearity issues (e.g., Intriligator *et al.* (1996)). The approach also allows us to impute the marginal value of both the measured attributes and the latent quality of neighborhood attribute.

Our approach is similar in spirit to the factor analysis approach of Kain and Quigley (1970) which constructs composite quality variables from a large number of observed quality measures. However, there is an important difference in the statistical treatment of the composite quality variables. While we explicitly take into account the latent structure of the quality variable in the statistical analysis, Kain and Quigley (1970) treat the constructed quality variable as if it was precisely measured. There are two problems with their assumption. First, the factor loading matrix is not known a priori—it is estimated. The estimation error of the factor loading matrix can lead to errors in the constructed quality variables. Second, the traditional factor analysis treats factors as unobserved random variables.