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OUTDOOR RECREATION, HEDONIC PRICES AND THE DEMAND FOR SOLITUDE: A NOTE

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INTRODUCTION

A number of economists have examined the effects of solitude (or its inverse, congestion) on outdoor recreation demand. For example, McConnell (1977) and Allen and Stevens (1979) found that the willingness to pay and consumer surplus of users of outdoor recreation facilities were related to disruptions in solitude. These studies did not, however, identify a demand schedule for solitude. In the absence of this information, the benefits of nonmarginal changes in solitude cannot be determined.

In this note we apply the theory of hedonic prices to specify a demand function for solitude. Cross-sectional data of campers in Western Massachusetts were used to estimate a set of implicit marginal prices and to derive the demand function. The benefits associated with nonmarginal increases in solitude were then obtained by integrating over the estimated demand function. Our results are tentative—indeed, the primary purpose of this note is to stimulate discussion and interest in the use of the hedonic technique.

THEORETICAL CONSIDERATIONS

It is hypothesized that outdoor recreation is valued for its utility-bearing attributes or characteristics (Rosen, 1974; Lancaster, 1966). Hedonic prices are defined as the implicit prices of these attributes and are revealed from observed expenditures on recreation and the amounts of specific characteristics associated with recreation. Examples of outdoor recreation characteristics include environmental attributes, such as accessibility and solitude. Let these be denoted by h and s respectively. The individual's utility function may then be written as:

$$(1) u = u(x, h, s)$$

where x represents attributes of all other goods. The individual's budget constraint is:

$$(2) Y = P_x X + E$$

where Y is income, P_x the price of x and E recreation expenditure. The latter depends on travel expenses and entry fee and could in a "full expenditure" model include value of time spent traveling and camping.

We assume a transformation function:

$$(3) E = p(h, s)$$

which implies that the individual transforms resources (travel expenses and entry fee) into characteristics (accessibility and solitude). Equation (3) may be substituted into (2) and the individual equilibrium position may then be obtained from the usual Lagrangian approach for constrained utility maximization:

$$(4) L = u(x, h, s) + \lambda(Y - P_x X - p(h, s))$$

The first order conditions are:

$$(5) \frac{\partial L}{\partial x} = \frac{\partial u(\cdot)}{\partial x} - \lambda P_x = 0$$

$$\frac{\partial L}{\partial h} = \frac{\partial u(\cdot)}{\partial h} - \lambda \frac{\partial p(h, s)}{\partial h} = 0$$

$$\frac{\partial L}{\partial s} = \frac{\partial u(\cdot)}{\partial s} - \lambda \frac{\partial p(h, s)}{\partial s} = 0$$

Assuming the marginal utility of income to be unity, $\lambda = 1$, equation (5) shows that the marginal utility derived from solitude,

$$\frac{\partial u(\cdot)}{\partial s}$$

must equal the marginal willingness to pay (or marginal expenditure) for solitude,

$$\frac{\partial p(\cdot)}{\partial s}$$

The marginal willingness to pay is derived from the hedonic price function for recreation, equation (3), which is estimated first. A set of marginal values or hedonic prices for solitude is then derived by differentiating equation (3) with respect to solitude, s . That is,

$$\frac{\partial p(h, s)}{\partial s}$$

is the implicit marginal value of solitude.

Under certain circumstances, the demand function for solitude may then be specified. First, we assume weak separability in the utility function, $u = u[x, g(h, s)]$, so that the marginal rate of substitution between any pair of characteristics is independent of the consumption of any other goods.

Given this assumption the demand function for solitude may be specified as:

$$(6) \frac{\partial p(h, s)}{\partial s} = H(s, I)$$

where I is a vector of demand shift variables. Without this assumption, the demand for solitude would be a function of the consumption level of other goods (see equation (5)) and the estimation of the demand function would require additional price and quantity data beyond that derived from equation (3). Second, we assume that the supply of solitude is perfectly elastic in order that the demand function may be identified.

EMPIRICAL ESTIMATION

Estimation requires selection of a functional form for equation (3), recreation expenditure data, and a set of attribute variables including solitude. The necessary data were drawn from a survey of campers in Western Massachusetts. Expenses of travel and entry fee to a specific site, hours of travel time, distance from the site, and feelings of solitude when at the site were obtained by a direct survey of campers. Data on the number of trips and length of stay were then used to calculate expenditure for the season. Distance and hours driving time were selected as accessibility attributes while the degree of solitude was specified by the individual interviewed on a five point qualitative scale.

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Two alternative functional forms of equation (5) were investigated: semi-log and quadratic. The quadratic OLS results were statistically superior and are reported in equation (7).

$$(7) E = -2.39 + 1.66TS - .0034TS^2 + .108D - 2.19HR$$

(2.28) (.081) (.0004) (.031) (.76)

$$R^2 = .93$$

where E is expenditure (travel cost plus entrance fee) at the site for the season; TS total solitude (individual feelings per day times days visited per season); D one-way distance; HR one-way travel time in hours; and numbers in parentheses are standard errors. As shown, all variables were highly significant. The results indicate that expenditure increases at a decreasing rate as total solitude increases; that the greater the distance the higher the expenditure; and that the more accessible the site in terms of hours of travel, the greater the expenditure.

Marginal or hedonic prices for solitude (PS) were then calculated for each individual surveyed by taking the derivative of (7) with respect to solitude, TS:

$$(8) PS_i = 1.66 - .0068TS_i$$

At the mean value of total solitude, PS = \$1.52. That is, if the average individual's feeling of solitude were increased by a small amount each day such that the marginal increment of solitude for the season was increased by one unit, the value of such a daily increment would be \$1.52 per season.

The demand for solitude, in its inverse form, was estimated by regressing the marginal prices in (8) against TS and individual income, Y. The results were:

$$(9) PS_i = 1.70 - .117LnTS_i - .002LnY_i$$

(.04) (.009) (.004)

$$R^2 = .67$$

By summing (9) over all individuals who visit in a season, the aggregate demand for solitude at the site can then be obtained.

IMPLICATIONS

We have hypothesized that there is no relationship between total campground use and individual feelings of solitude. Rather, we assume that solitude is provided at the campground, and that the

benefits of solitude represent the value of campground management programs such as site spacing, planting of visual screens, etc. Further research is, however, obviously required. First, we have assumed that the supply of solitude is perfectly elastic. For campground management purposes, an investigation of the determinants of the supply of solitude is, of course, required. Second, additional research of the relationship between total campground use and the supply of solitude is needed. Third, the hedonic technique itself warrants further investigation. In this note we have attempted to illustrate how the technique may be used to value the benefits of nonmarket goods and services such as solitude. A principal advantage of the technique is that it relies on observed as opposed to hypothetical behavior to value nonmarket natural resources. Clearly, however, we have employed separability and model specification assumptions which deserve further attention. Further investigation is required along the lines suggested for other nonmarket attributes by Freeman, Rosen, and Harrison and Rubinfeld to: (a) better define expenditures; (b) establish the relationship between the utility function assumed and the econometric model; (c) specify the appropriate functional form of the econometric model; and (d) define the relevant recreation attributes.

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