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Incorporating Users' Perceptions of Site Quality in a Recreation Travel Cost Model

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The travel cost method is used to analyze the recreation demand for North Carolina trails. Incorporated in the demand model are users' perceptions of trail quality and their stated number of annual trips. Trail demand is specified with panel data that consists of two separate observations per respondent. Users' behaviors are analyzed by combining both data on the observed trip counts and stated trips. Stated trips are the number of trips a user would have taken to the last trail used had the site quality been ideal. Since both users and non users of trails during the past 12 months were asked their stated trips if quality improved, the non-participation effect was incorporated into the estimates of trail demand. Study findings showed users' ratings of trail quality can be successfully incorporated into a demand model to evaluate a hypothetical improvement in trail conditions. The estimated $15 increase in consumer surplus per trip is of practical importance to policy analyses aimed at improving social and environmental conditions averse to trail users.

KEYWORDS: *Recreation demand, trails, travel cost method, outdoor recreation, contingent behavior*

Introduction

We know recreationists reveal their preferences for particular sites through a series of choice decisions, which involve different sets of travel costs and substitute sites of varying qualities (Smith, 1989). Recent extensions to recreation participation surveys supplement the observed survey data with one or more contingent behavior questions (Englin & Cameron, 1996). We now confront users with hypothetical choices like having an individual state the number of trips they would have taken given either changes in site quality or varying percentage changes in trip prices (Whitehead, Haab, & Huang, 1998; Englin & Cameron, 1996; Layman, Boyce, & Criddle, 1996; Ward, 1987). Analysts may even specify trip response models when individuals have not taken previous trips to sites (Loomis & Walsh; Bayless, Bergstrom, Messonnier, & Cordell, 1994; Loomis, 1993). Overall, analysts have found con-

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tingent behavior questions to be a valuable supplement to observed data (Englin & Cameron, 1996; Loomis & Walsh, 1997).

Using the travel cost method, we specify a random effects model to estimate the demand for North Carolina trails.[1] The panel data consist of two separate observations per respondent. The first observation records the observed trip counts at the reported quality. Quality is defined by each user's overall rating of the social and environmental problems experienced at the last trail used. The second observation captures the stated trips, if trail quality had been ideal at that last trail used. From a statewide telephone household survey, we selected only those respondents for study who had used North Carolina trails and greenways. Some individuals in our sample had used North Carolina trails, but not during the past 12-month planning horizon. We asked all our respondents what their stated trip behaviors over the last 12 months would have been, had the site quality at the last trail used been ideal.

Recreation Demand and Contingent Behavior

A trail user behaves to maximize utility (satisfaction) with trail trips and other household goods and services, given a binding income constraint. A user's price for participating in a trail activity is the sum of the travel costs to reach the trail site and return home and the opportunity cost of round-trip travel time. We assume the round-trip price remains the same, despite the number of annual trips. Also, we assume recreationists know the proportions of money and time needed to take each trip, and can compare all possible trip decisions to maximize satisfaction (Smith, 1989). Recreation demand is estimated by examining the relationship between seasonal trip counts and prices. (See Loomis & Walsh, 1997, for an introduction to the travel cost method, and Fletcher, Adamowicz, & Graham-Tomasi, 1990, for a discussion of the assumptions, estimating issues, and more.)

Analysts augment the travel cost method by constructing scenarios of proposed changes in quality or trip prices (Englin & Cameron, 1996). The proposed actions in many management cases are to improve quality by eliminating certain social and environmental problems. Users are expected to respond to the changes by intending to take more seasonal trips (Loomis, 1993). Even some nonusers who took no trips during the past season are expected to begin using the recreation sites if quality is improved. Although viewed as an improvement by resource managers, a minority of users may in

[1]Trails settings examined range from narrow paths, to paved bicycle trails and greenways, to off-highway vehicle trails. Un-surfaced trails are generally narrow, unimproved, and have a natural dirt surface. Examples include backcountry trails, paths, most of the Appalachian Trail in the state, and trails in North Carolina State Parks. Surfaced trails have bark chips, gravel, cement, or asphalt surfaces, and are typically wider and more heavily used than un-surfaced trails. Sidewalks, streets, and bicycle lanes are not considered trails for the purpose of this study.

fact perceive any site change as a threat to the site's attractiveness. As a result, users might value observed quality conditions more than they would value well-intended management changes.

Trail Quality

Researchers have reported that users' perceptions of site characteristics affect the selection and substitution of sites (Fletcher, Adamowicz, & Graham-Tomasi, 1990). Many adverse trail conditions are simply exogenous to the users (i.e., not the fault of users as with poor maintenance). However, this is not true for site congestion where the very fact that a user decides to participate in a trail activity contributes to a trail's congestion (Jakus & Shaw, 1997; Douglas & Johnson, 1992).

In this study, users' perceptions are ex post ratings of overall trail quality because users eliminate the uncertainty of adverse problems by having been on-site. Obviously, users' perceptions of site quality will still be somewhat subjective even having been on-site because their preferences and tastes vary (Ditton, Fedler, and Graefe, 1983; Hammitt, McDonald, and Noe, 1982). The on-site perceptions of users in this study should not be confused with the ex ante perceptions about site conditions users expect to see before actually traveling to the site (Jakus & Shaw, 1997). Often the ex ante estimates of quality are based on past site experiences and, then, extrapolated to future conditions (Jakus & Shaw; McConnell & Sutinen, 1984).

Rating instruments of on-site conditions have a long tradition in recreation studies. While the problems with on-site bias (e.g., endogenous stratification) are well known, many analysts still feel there is no acceptable substitute measure that compares to the direct on-site experiences of users (Michael & Reiling, 1997). They acknowledge the subjectivity of individual responses about site conditions, but believe the varying preferences and tastes of the different users should be considered in attempting to understand site demand (Hammitt, McDonald, & Noe, 1982).

Methods

A random sample of 2,026 adults, 18 years and older, was contacted by telephone statewide during the Spring and Summer of 1998 for a trail and greenway survey. Of interest to us were the approximately 32% (n = 647) of the telephone interviewees who indicated they had used North Carolina trails in the past 12 months. Of these interviewees, 346 returned the follow-up mail questionnaires that described their most recently used trail. However, approximately 14% of these respondents took zero trips during the previous 12 months. Yet, their stated number of trips showed that they would have taken trips to the last trail they used during the past 12 months had the site quality been to their ideals. In comparing those respondents who returned the mail questionnaire with non respondents, a non significant association [$\chi^2(11) = 6.557$, Pr = .834] was found with respect to their annual incomes.

The relevant mail survey questions elicited responses about the trail most recently used. Instructions to respondents were explicit. "Please take a moment to reflect on the last trail you used in North Carolina. The next 11 questions pertain to your trip to that trail, your experience while on that trail, and the characteristics of that trail during your most recent visit." Of the 11 questions, three were key to this research.

The first question pertained to how often each respondent used the most recently visited trail during the last 12 months. In the second key question, respondents compared the trail last used to their image of that trail if conditions there had been ideal, perhaps with a beautiful setting, easily accessible, well designed, maintained, safe, and not crowded. On a 5-point scale, ranging from "it was not at all ideal" to "it was ideal," respondents revealed how the last trails visited compared with their ideals. To prepare respondents for this question, we first collected their perceptions about environmental problems and their interactions with other trail users. Respondents rated potential problems on a 5-point scale "from not a problem at all" to "a serious problem." Examples of potential problems were reckless behaviors of other users, rough trail surface, poor trail maintenance, pets off leash, dangerous road intersections, and conflicts with other activities.

As the respondents' perceptions of the overall site quality increased, each problem decreased in its importance. Although respondents reported different trail activities, they were consistent in perceiving adverse conditions at the trails last used and the dependent variable, overall trail quality, similarly. Somers' D, an ordinal statistic, assessed the associations between the dependent variable and the respondents' perceptions of potential problems.[2] All the coefficients were statistically significant at the .01 levels and negative in their signs.

The third question elicited the contingent behavior data. It directly followed the second key question. Each respondent answered, "How many times would you have used that particular trail during the 12 months if it had met your ideal?" Loomis (1993) offered evidence about the reliability of stated trips. In investigating users' trips to Mono Lake, CA, the stated trips showed the same test-retest reliability as the current trips.

Trail Demand

Our representation of trail demand involved a simplification of the multiple sites participation model. We pooled respondents' trip counts to different trails into a single demand model (Freeman, 1993, p. 462). We therefore could not specify substitute prices to the other trails. In our attempt to elicit the miles respondents would travel to visit a similar trail, if that trail most recently used had been closed, over half the respondents recorded a missing response. This question was dropped from analysis. The exclusion of substi-

[2]The formula and statistical routine to calculate Somers' D values can be found in Stata (1999, Version 6).

tute trails in analysis may result in the overstatement of consumer surplus estimates (Fix & Loomis, 1997).

Trip prices included a cost per mile of 14 cents multiplied by the two-way distance to the trail; plus a fixed rate of 33% for the opportunity cost of time multiplied by each respondent's hourly wage and round-trip travel time (Hof & Rosenthal, 1987).[3] Five percent of the respondents bicycled, jogged, or walked to local trails, and were assigned a zero vehicle cost per mile. The mean price was $23.88 per trip. It is important to note that the observed number of annual trips changed relative to the number of stated trips due to the proposed change in trail quality, and not travel costs. Trip costs are unbiased measures of the proposed change in trail quality (Layman, Boyce, & Criddle, 1996).

In specifying trail demand, we faced two important issues in the selection of an appropriate regression estimator. First, the dependent variable was a count of the number of trips a respondent took in the last 12 months. The number of trips is a nonnegative integer, rather than a continuous variable as assumed in a normal distribution (Fix & Loomis, 1997). In particular, the Poisson distribution, when applied to the trip generation process is more consistent with the decision making behaviors of respondents. Most of the trail users take few trips per annum, and the Poisson distribution provides a closer approximation to the data. Observed counts of annual trips ranged from zero to 200 with a mean of 5.29 trips. In contrast, the stated annual trips (M = 10.39) ranged from one trip to a single recorded response of 360 trips.

Second, the trail demand data were a cross section of sampled individuals. We combined the stated number of annual trips with the observed trip counts to the trail last used for each respondent as two separate records to form a panel (Englin & Cameron, 1996). One record included the observed trip counts. The second contained the number of stated trips, if site quality at the last trail used had been ideal. We restricted the sample to those respondents who provided a complete set of observations. This produced a balanced panel with a total of 736 observations for 368 respondents. The mean values of the independent variables across the 736 observations are reported in Table 1.

A random-effects panel estimator was selected for several reasons. Respondents were randomly selected from a statewide population of trail users, and the quality of trails was not fixed (Greene, 1995). Explicit estimations of the effects of trip prices and user characteristics upon the demand for trails did not vary across the observations of each respondent and were important to the assessment of trail use (Englin & Cameron, 1996). Correlations across the observed and stated demands for trails can be controlled with a random-effects estimator and a Poisson distribution.

We specified the travel cost model for r annual trip counts as:

[3]A vehicle operating cost of 14.1 cents a mile was reported to us by the North Carolina State's Motor Vehicle Department.

TABLE 1
Random-Effects Poisson Travel Cost Model

Independent Variables	Coef.	Std. Err.	Means
Trip price	−.036	.006	23.576
Multi-activity participants	.446	.136	.359
Surfaced trail	.900	.152	.250
Quality rating	.304	.016	4.164
Quality rating * trip price[a]	.005	.001	98.957
Constant	.521	.131	
Alpha (α) parameter[b]	1.301	.093	
Likelihood ratio test of alpha = 0, $\chi^2(1)$ = 9,637			
Log-likelihood = −2,129			
Number of observations = 736			

[a]The asterisk indicates an interactive term.
[b]The χ^2 (chi-square) value in the estimator asserts that there is common variation in individual responses across observed and stated behaviors.

$$\ln(r_t) = \alpha + \beta p + \gamma q + \delta(q * p) + \zeta x + u + \varepsilon.$$

Note the subscript t on the dependent variable refers to the two observations per respondent. The remaining subscripts are dropped for simplicity. The symbol ln is the natural logarithm of trip counts. We specified trail trips as a function of trip prices (p), overall quality ratings (q), an interaction term between the quality ratings and trip prices ($q * p$), other site and user characteristics (x), and individual effects (u). The error term is the combined effect of unobserved variables omitted from the model and other sources of randomness.

Trip counts and the quality ratings could change between the observed and ideal trail conditions. On the first record for each respondent, the quality rating (q) was set at the value the respondent assigned to the trail most recently used (M = 3.33, SD = .846). For the second record with the stated number of trips, the quality rating was set at a value of five, the ideal quality. Trail ratings were incorporated into demand analysis to test for the difference in the observed and the stated demand for trips. An interaction term between quality and trip prices was included to allow the trip price coefficient to vary with trail quality (Vaughn & Russell, 1982).[4]

Results

The travel cost model was significant in explaining annual trail use (χ^2 = 743, Pr > χ^2 = .000). The log-likelihood value in Table 1 and the associated chi-square value showed the specified model to be significantly

[4]We recognize this specification may have a limitation in our empirical application because of the uncertainty that all substitute trails in North Carolina were included in our sample data.

different from a model with an intercept term only (Long, 1997). The resulting demand coefficients from the panel estimator are in Table 1. All the independent variables and the constant term were significant at the .001 levels (Pr > z value). The random-effects parameter, alpha (α), was significant, showing common variation in the individual responses across both observed and stated observations. A likelihood ratio test of $\alpha = 0$ compared the panel estimator with just a Poisson estimator. Trip counts were significantly different between the observed trail quality and ideal state, and consequently, the random-effects estimator was significantly different from using just a Poisson estimator. Specification of an interactive term between the overall ratings of trail quality and trip prices was a statistical method to account for the influence of the price and quality relation on demand (Vaughan & Russell, 1982).

Taking the exponents of both sides of the travel cost model yields:

$$r = \exp(\alpha - \beta p + \gamma q + \delta(q * p) + \zeta x).$$

A negative sign precedes the trip price coefficient (β), which means trip prices increase as the annual trip counts decrease. The marginal effect of a price change is the slope of the trail demand curve. Substituting the coefficients for price and price-quality (δ), the mean price (p), and an estimate of the annual trip count (r) into $(\beta + \delta p)r$, the marginal price was $-.10264$ trips per dollar increase in travel costs.[5]

Quality ratings positively affected demand. Users would take more annual trips to the trails last used, if those trails were of higher quality. Since the quality coefficient ($\delta = .304$) is greater than zero, an alternative trail would become a less desirable substitute with the proposed improvement in trail conditions from the users' quality ratings ($\delta r = .0269$).[6] The marginal effect of a point change in trail quality on the demand for annual trips was 2.37 trips.[7] As the respondents moved away from experiencing adverse trail conditions, the stated trip response curve shifted outward to the right away from the observed demand curve for trips.

Regarding the remaining significant influences on trail demand, approximately 36% of the trail users participated in more than one trail activity during the past 12 months (e.g., walking for pleasure, hiking, motorized activities, etc.). In fact, users participating in multiple trail activities took 1.56 [= exp(.4462302)] more trips, holding all other variables constant, than did

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[5]The expression in the text is derived from calculus or $\partial r/\partial p$, which refers to the partial derivative of trip counts with respect to trip prices.

[6]To obtain the change in quality we take the partial trips with respect to price and then again with respect to price ($\partial^2 r/\partial p^2 = \delta r$).

[7]Since the random-effects Poisson estimator is a non-linear estimator, the partial derivative, $\partial r/\partial q = (\lambda + \delta p)r$, cannot be interpreted as the change in the expected count of annual trail trips for a unit change in quality as one would do in an OLS application. We therefore compute the marginal effects at the means. (See Long, 1997, p. 224, for an extended discussion on the appropriate interpretation of count-data estimators.)

those participating in single activities. Use of a surfaced as opposed to unsurfaced trail significantly influenced demand by 2.46 [= exp(.90046570)] trips annually.

Discussion

We present a travel cost model that combines the observed trip counts and quality with stated trips under ideal quality. The contingent behavior approach estimates the change in demand for trails in North Carolina and the gain in consumer surplus associated with a proposed change in trail quality. At the means, the estimated individual demand is 5.79 trail trips per annum. The State demographer estimates that 5,630,142 individuals, 18 years and older, live in North Carolina. From the telephone survey, we know 32% of our random sample visited a North Carolina trail during the last 12 months. We can approximate the aggregate demand by state residents for North Carolina trails as 10.4 million trips in 1998 to the 3,660 miles of recreational trails available in the state.

The consumer's surplus (CS) per trip for a demand model with a price-quality interaction term is equal to $-1/(\beta + \delta q)$ (Englin & Cameron, 1996). From the coefficients on trip price and price-quality variables and the mean quality value, the CS per trip was $56.42 under existing trail conditions.

Our purpose in asking a contingent behavior question was to extend the demand function for existing trails beyond the observed data. Our survey instructions were explicit. We asked respondents to take a moment to reflect on the last trail they used in North Carolina and the ensuing questions pertained to that most recently used trail. The key contingent behavior question elicited the number of stated trips respondents would have taken had that trail met their ideal. If the ideal conditions of users were met, the stated trips would be 8.16 per annum and the CS per trip would be $71.46. In a policy context, both values would represent the potential gains in recreation benefits from improvements in existing conditions.

In conclusion, we began this analysis by speculating whether proposed changes in existing trail conditions could really influence demand for trails. The subjective impressions of trail conditions by users do apparently influence demand. We incorporated users' perceptions of existing trail conditions and, then, extended the observed data with the stated trips that the respondents would have taken had trail conditions been ideal. The results support including users' perceptions of site quality in travel cost models. By augmenting the travel cost with contingent behavior data, we were able to document an increase in trail demand for a hypothetical change in trail quality.

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