THE ECONOMICS OF OUTDOOR RECREATION CONGESTION: A CASE STUDY OF CAMPING

P. Geoffrey Allen and Thomas H. Stevens

Bias in estimating recreational values may result if congestion is ignored in the demand model specification. Theoretical and empirical considerations pertaining to recreation congestion are summarized. Empirical results for camping in Western Massachusetts are presented which demonstrate the potential degree of bias from demand model misspecification. The results indicate that recreational values may be strongly influenced by congestion effects and that camping areas with relatively low densities may have a higher economic value than high density areas with similar facilities.

INTRODUCTION

Outdoor recreation is becoming an increasingly popular activity and consequently congestion can be expected to become a more serious problem. While substantial progress has been made toward developing theories and methodologies to estimate the demand for and value of recreational resources, these efforts have provided little information on either the management of congestion or the interrelationships between congestion and economic value.

The effects of excess demand for a recreation activity can appear in two ways; either as restrictions on entry to a site or as increased density of participants at a site. In the first situation, a recreation site may have a physical or administratively determined capacity that, when reached, results in entry refusal (e.g., some U.S. public campgrounds). Those recreationists willing to pay the entry fee, if any—must recognize a probability of being excluded by non-price rationing. This uncertainty would only be removed by a guaranteed reservation system. McConnell and Duff demonstrate that because this probability is altered by the level of entry fee, an individual may respond differently to an increase in fees than to an increase in travel cost. Consequently, the traditional travel cost demand estimation procedure, which assumes that an increase in entrance fees is treated in the same fashion as an increase in travel costs, will understate the true economic value of the recreational resource (McConnell and Duff).

In this paper we examine the type of congestion in which an effective capacity constraint is absent. Increased visitation results in either a higher site density or waiting lines (e.g., downhill skiing) leading to diminished enjoyment by each participant. Congestion of this type may reduce both the satisfaction derived from recreation by participating individuals and the net returns accruing to resource owners. Wetzel has recently demonstrated that the travel cost demand estimation procedure will also understate the economic value of a recreational resource when congestion of this type occurs.

Willingness to pay demand models estimate benefits only for the conditions existing at the time of data collection. As noted by Ravenscraft and Dweyer, "If the data are collected on different days at various levels of congestion, and if congestion is significant, then aggregation of the days to form one model will result in a misestimation of benefits." (p. 3)

These findings are of significance since good decisions as to where and when to develop new recreational facilities depend in part upon accurate economic demand projections. Moreover, economically efficient use of the natural environment requires a balancing of the net returns to each of its possible uses. The resource allocation decision depends in part upon recreational values (preservation) relative to the value that could be derived from other uses (development). If recreational values are misestimated, due to congestion, then the allocation of natural resources between preservation and development uses may be incorrect. Yet, appropriate modifications of either the travel cost or "willingness to pay" demand estimation procedures have not been fully developed.

In this paper, we examine the potential bias resulting from a misspecification of travel cost and willingness to pay models under congested conditions. Empirical results for camping in Western Massachusetts are then presented which provide quantitative evidence of the degree of bias that may result from demand model misspecification.

PREVIOUS WORK

The issue of congestion has been addressed by a number of authors (McConnell, Cicchetti and Smith, Deyak and Smith, Wetzel). Cicchetti and Smith found that the willingness to pay and consumer surplus of users of the Spanish peaks wilderness area were significantly related to disruptions in solitude where solitude was measured in terms of the number of encounters with other parties. McConnell, using actual site density as a congestion variable, reached a similar conclusion with respect to users of Rhode Island beaches. However, the sociological studies reported by Heberlein revealed that correlations between user's satisfaction and density of use were not always statistically significant.

The question of whether congestion influences the length of stay, number of visits or the decision to participate has been investigated by some authors and avoided by others. In McConnell's specification an individual's willingness to pay per day was highly related to number of (one day) visits per season by that individual. Deyak and Smith recently examined the effect of congestion upon the probability of participation and the quantity of participation for remote and developed camping. Using a cross-sectional data base developed from the 1972 National Recreation Survey, variations in the probability of and quantity of participation were related to variations in leisure time, age, income, sex, per capita campsites in each state, and wilderness users per wilderness acre in each state. Probability of participation was inversely related to the level of congestion (wilderness users per wilderness acre), but a significant relationship was not found between the rate of participation and the level of congestion. They therefore concluded that, "congestion was most likely to affect the decision to participate and not the level of participation." (p. 79)

On the other hand, Oliveira and Rausser avoided the influence of the participation decision by assuming separability in decision making to the extent that both the determination to camp and the length of stay had previously been made. They then focused on estimation of the reduced form use equation. A principal components approach was employed to explain the variation in use between campgrounds and between camping dates. Pooled

cross-section (between campgrounds) and time series data were used in the analysis. Independent variables included total use at all campgrounds in the current time period, total use lagged, temperature and campground attributes. They suggested that lagged total use could influence the household's expectation of campground congestion. From economic theory we would expect that a "congestion" variable would carry a negative coefficient, whereas a positive relationship between use lagged one period and the use in the current time period was found. This result may of course indicate a partial adjustment mechanism totally unrelated to congestion. Yet, the results also indicated a negative relationship between use lagged two periods and use in the current time period.

The inconclusive empirical evidence is due, in part, to the lack of an appropriate theoretical structure—an issue to which we now turn.

THEORETICAL CONSIDERATIONS

Let x represent the number of trips made by a recreationist to a given site per season and z a composite variable for all other goods. For each trip a travel cost of t is incurred and an entrance fee of p is charged. The total expenditure for x visits to the recreation site is therefore $x(t + p)$. If the price of z is p_z and y is money income, then the individual's demand for the site can be obtained from the usual constrained utility maximization approach. Form the Lagrangian expression:

(1) $L = U(x,z) + \lambda [y - x(t + p) - p_z z]$.

The first order conditions are obtained by differentiating (1) with respect to each variable and setting each equal to zero.

(2) $\frac{\partial U}{\partial x} - \lambda[t + p] = 0$, $\frac{\partial U}{\partial z} - \lambda p_z = 0$, and $y - x(t + p) - p_z z = 0$.

Solution of the set of equations (2) yields the demand function for number of visits:

(3) $x = f(t + p, p_z)$.

Congestion may be considered as an externality entering the individual's utility function. If congestion is defined in terms of encounters with other people represented by number of visitor days, N, the utility function may then be written as:

(4) $U = U(x,N,z)$.

This might, following McConnell's suggestion, be specialized into two additive components:

$U = U_1(x,z) + U_2(x,N)$

in which the degree of congestion does not affect the utility gained from other goods.

The demand function would then be specified as:

(5) $x = g(N, t + p, p_z)$.

The bias which results from a misspecification of the demand function may be shown graphically by means of a simple hypothetical example. First assume that a site demand curve based on the price/consumption points A, B and C in Figure 1 is estimated. This function might have been derived from observed data of the following type:

Individual	Season Visits	Travel Cost
1	4	$1
2	2	$3
:	:	:
n	0	:

Treating travel cost as a price proxy and assuming a population with identical socioeconomic characteristics, the ith individual's demand function is given by:
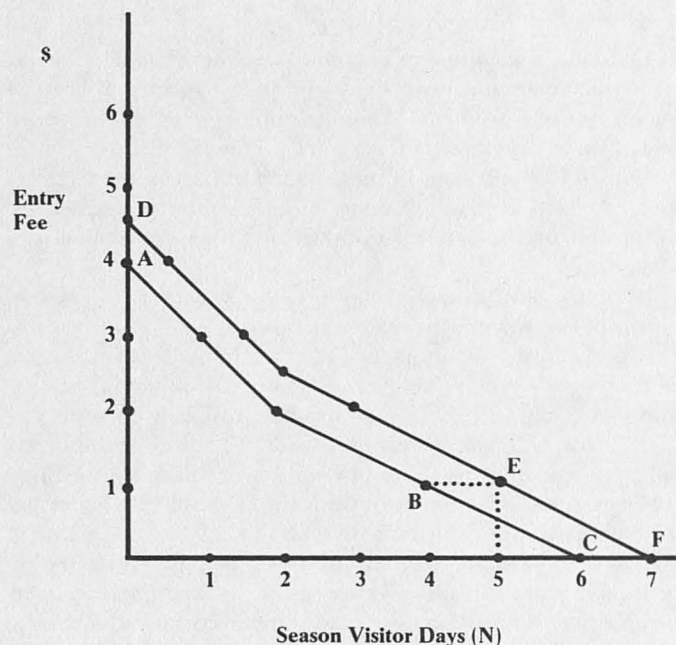
(6) $x_i = 5 - (t_i + p)$.

The aggregate site demand would then be expressed as:

(7) $\sum_{i=1}^{2} x_i = N = 6 - 2p$ for $p \le 2$.

However, if congestion is a factor, the observed data *also* may be explained by, for example:

(8) $x_i = 8 - (t_i + p) - .5(N)$.

Figure 1: Demand Estimated Under Congested Conditions

Season Visitor Days (N)

The aggregate site demand, including the congestion effect, would then shift outward as total use, N, decreases.

Given the numerical example above, a zero entry fee yields an economic value of $10 measured from the demand curve ABC and equation (7).[1] If the fee is increased to $1, total use is reduced to 4. But, from equation (8) the demand curve shifts outward to DEF. The economic value is then $12.25. That is, an observed demand curve based on the price-consumption points A, B, C is not appropriate for the evaluation of recreational values. Each point on A, B, C, actually represents the consumption of a different good as defined by Ravenscraft and Dweyer.

This problem may be viewed in another light. By asking willingness to pay questions when respondents perceive different levels of congestion, a series of demand curves of the type ABC, DEF can be generated, one for each level of congestion. There is only one price (or entry fee) for each demand curve where the number of visitor days corresponds to the degree of congestion that generated the demand curve in the first place. This point is a member of the set of observable equilibrium points that Wetzel refers to as the "congested corrected [demand] curve."

The bias from model misspecification may be either upward or downward. In the numerical example, if the demand schedule ABC is used to estimate economic value given a total use of 5,

the value will be underestimated. On the other hand, if curve DEF is used to estimate economic value given a total use of 6, an overestimate results.

EMPIRICAL RESULTS

The overall empirical evidence indicates that the congestion effect may be strong for wilderness recreation and less important for activities such as swimming. Yet, as noted, little evidence of the effect of congestion in developed camping is available. To estimate the effect of congestion for this activity a campground survey was designed and administered in Western Massachusetts during the Summer of 1978.

For the empirical analysis, a model specification of the type employed by McConnell, Cicchetti and Smith, and Deyak and Smith was initially used. That is, a function of the following specification was estimated.

$$(9) \ \ln W_i = a_0 + a_1 \ln y_i + a_2 \ln q_i + a_3 \ln x_i + \varepsilon_i$$

where W_i is consumer surplus (willingness to pay above travel costs) for the ith individual per day, y_i income, q_i congestion measured in terms of the percentage the campground was full that day as perceived by the respondent, x_i the length of stay of the ith individual and ε_i the disturbance term. The ordinary least squares estimate of equation (9) is presented in equation (10):

$$(10) \ \ln W_i = 1.46 + .007 \ln y_i + .017 \ln q_i - .054 \ln x_i$$
$$\qquad\qquad\quad (.005) \qquad (.021) \qquad (.025)$$

$$R^2 = .11$$
$$F = 3.078$$
$$n = 81$$

The numbers in parentheses are standard errors.

The results indicate that only eleven percent of the variation in willingness to pay was explained by this model. Moreover, the variable for congestion, percentage full, was of the wrong sign and statistically not significant. Consequently, alternative procedures for measuring congestion were explored. First, congestion was defined in terms of individual feelings that day, S, (e.g., very secluded, somewhat secluded, somewhat crowded, very crowded). The results are presented in equation (11).

$$(11) \ \ln W_i = 1.45 + .007 \ln y_i + .03 \ S_i - .06 \ln x_i$$
$$\qquad\qquad\quad (.005) \qquad (.04) \quad (.03)$$

$$R^2 = .05$$
$$F = 1.18$$

Congestion, as measured by individual feelings as opposed to a physical measure, was not a significant factor in explaining the willingness to pay for the recreational resource. In fact, the survey site was physically developed in such a way that no one in the sample felt "very crowded." Consequently, it was concluded that a sense of crowding seldom occurred even when the site was full. This was attributed to site spacing and the use of vegetation screens between sites.

To increase the range of value over which congestion could take, a congestion bidding game was devised. Congestion was redefined as the number of occupied sites within the existing camping area, q_j^*. Specifically, campers were asked their willingness to pay, above travel cost, for a day's camping for various site densities. Responses were obtained for seven different densities, including the current density. This was done by hypothetically removing and adding occupied sites to the camping area. That is, the number of occupied sites within the physical confines of the existing camping facility were "increased" or "decreased" from the current density level.

As noted by Randall and Brookshire, economists have defined several possible biases which may result from such a technique: starting point bias, vehicle bias (method of payment), and information bias. However, "these kinds of biases are not endemic to bidding mechanisms. Rather, they may occur in particular applications in which the lack of context correspondence causes problems." (p. 13)

Consequently, the congestion bidding game was designed to simulate a hypothetical market in which the camper could buy situations not currently provided, and for which a fee would normally be charged. In other words, particular attention was devoted to the design of a game with context correspondence.

The bidding game results may be summarized by the following regression relationship:

$$(12) \ W_{ij} = 5.39 + .000046 y_i - .029 q_j^* - .13 x_i$$
$$\qquad\qquad (.28) \quad (.000011) \quad (.0029) \quad (.06)$$

$$R^2 = .26$$
$$F = 41.71$$

where q_j is the congestion variable, as defined above, and x_i the number of trips per party during the season.

If all individuals are assumed to be alike with income and number of trips at the sample mean values, then:

$$(13) \ W_{ij} = 5.58 - .029 q_j^*.$$

That is, depending upon the density, the average individual's willingness to pay would range between $5.58 and $3.23 per day.

The results were also used to construct aggregate site demand functions. First, each party (respondent) was placed into a category corresponding to its monetary evaluation for a given density. For example, the following data were obtained given a specified density of 51 parties per day within the camping area (the existing number of campsites and the base density in the bidding game).

Willingness to Pay Price ($)	Cumulated Total Parties Per Day Willing to Pay
8.00	1
7.50	2
6.50	5
6.00	12
5.00	42
4.50	60
4.00	76
3.50	80
3.00	81

where n = 81.

By extrapolation, a $4.75 fee would result in a density of 51 parties per day. By repeating this process for each density, a congestion corrected relationship between the entrance fee, daily campground revenue, consumer surplus and density was obtained (Table 1).

As shown in Table 1, campground revenue would be maximized by limiting attendance to 51 parties per day through the imposition of a $4.75 entrance fee. However, the economic value of the recreational resource (revenue plus consumer surplus) would be maximized by imposing a $3.25 fee.

We selected at random out of the sample one individual set of responses to illustrate the potential degree of bias which may result from model misspecification. This individual would have indicated a willingness to pay ranging from between $6.50 and $10.00 per day depending upon the density. A site oriented survey asking willingness to pay questions that fails to measure the degree of congestion may give rise to biases of this magnitude.

Table 1. Relationship Between Economic Value and Density

Parties Per Day (Density)	Entrance Fee	Campground Revenue Per Day	Consumer Surplus Per Day	Economic Value
	$	$	$	$
81	0	0	232.50	232.50
68	3.25	221.00	86.25	307.25
51	4.75	242.25	27.50	269.75
31	5.50	170.50	21.50	192.00
17	6.25	106.25	12.50	118.75
9	6.50	58.50	9.50	68.00

CONCLUSIONS

Demand model misspecification may result in a serious bias when estimating resource values associated with developed camping facilities. Camping areas with relatively low densities may have a higher economic value than similar high density areas because of the congestion effect. Moreover, increasing access to areas with low densities may reduce economic values. As Wetzel points out, this issue may be of great importance in the process of evaluating projects such as reservoirs which replace low density recreational activities with high density areas. Although a methodology exists for estimating impacts of congestion in "willingness-to-pay" models, procedures for appropriate modifications of the travel cost approach await development. Until such modifications are implemented, recreational value estimates must be viewed with caution.

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FOOTNOTES

P. Geoffrey Allen and Thomas H. Stevens are Assistant Professors of Resource Economics, University of Massachusetts.

[1]Economic value as defined is revenue (entrance fee multiplied by quantity) plus consumer surplus above the entrance fee.