Journal of Agricultural and Applied Economics, 28,2(December 1996):423–432

Toward a Value for Guided Rafting on Southern Rivers

J. M. Bowker, Donald B. K. English, and Jason A. Donovan

ABSTRACT

This study examines per trip consumer surplus associated with guided whitewater rafting on two southern rivers. First, household recreation demand functions are estimated based on the individual travel cost model using truncated count data regression methods and alternative price specifications. Findings show mean per trip consumer surplus point estimates between $89 and $286, depending on modeling assumptions and river quality. Magnitudes of these surpluses are very dependent on assumptions about the opportunity cost of time.

Key Words: consumer surplus, count data, guided rafting, travel cost.

The nation's fast flowing rivers are an example of a public resource providing potentially large noncommodity benefits to society. On many of these rivers, recreation, in the form of guided rafting, is one of the predominant noncommodity uses. Such an activity is dependent on in-stream flow that may conflict with hydropower demands. Further, demand is affected by the perception of wildness or naturalness, the presence of which may conflict with development or extractive land use objectives. Consequently, good information about the value of guided rafting on these rivers should be an important ingredient in management decisions dealing with these rivers and their corridors.

J. M. Bowker and Donald B. K. English are research social scientists with the USDA/Forest Service, Southern Research Station, Outdoor Recreation and Wilderness Research Unit, Athens, Georgia. Jason A. Donovan is a U.S. Peace Corps volunteer in Uruguay, and former undergraduate student in the Department of Agricultural and Applied Economics, the University of Georgia.

The authors acknowledge the valuable assistance of David Brown with America Outdoors and the constructive comments of two anonymous reviewers.

In this analysis, we use a variant of the travel cost method (TCM) to estimate the per trip consumer surplus for guided whitewater rafting on the Chatooga River, which forms part of the northern border between Georgia and South Carolina, and the Nantahala River in rural western North Carolina. These rivers provide an estimated 50,000 and 140,000 commercially guided rafting trips per year, respectively. In addition, they offer somewhat different trip characteristics. For example, the Nantahala trip is at least three hours in duration and consists of relatively low-intensity rapids (one short, class III rapid). The Chatooga, one of the nation's designated Wild and Scenic Rivers, is both more intense (with many class III and IV rapids, and some class V), and a longer ride, generally lasting about six hours. While these rivers do not fully reflect the diversity of river rafting opportunities in the South, we think they are representative of two important classes of guided whitewater rafting, and our results are a good starting point for benefits transfer values.

We estimate demand using an individual travel cost model (ITCM) and a truncated sample based on guide records. In the process, we propose a method of dependent variable creation which reasonably circumvents the lack-of-dispersion problem endemic to individual travel cost modeling. We also examine differences between the use of imputed travel costs based on distance and a cost-per-mile factor, and reported travel costs based on a detailed expenditure survey. Finally, we assess the influence of an imputed travel time cost across each model.

Methods

The travel cost method is based on reported behavior and a number of assumptions, foremost of which is that individuals perceive and respond to changes in the travel-related component of the cost of a visit to a recreation site in the same way as they would respond to a change in admission price (Freeman). TCM in its various forms (see, e.g., Fletcher, Adamowicz, and Graham-Tomasi; Smith; or Ward and Loomis) has been lauded for its behavioral base and is generally accepted for estimating nonmarket use value in water resources related studies (U.S. Water Resources Council).

Economic surplus may be derived via the TCM construct indirectly by developing a quantity (trip)/price (travel cost) relationship empirically and solving for Marshallian or income-constant consumer surplus. The theoretically more appealing Hicksian measures can also be easily obtained (Creel and Loomis). However, in situations where income effects are small, including most outdoor recreation trips, Marshallian and Hicksian measures should be reasonable approximations.

In general, TCM is not without its limitations. The most obvious of these is its limitation to use value. Moreover, as Randall points out, it is still an indirect or inferential means for quantifying values. As such, in spite of its direct link to actual behavior, some "art" is required to get from reported trips to consumer surplus. Also, from an ex ante policy analysis perspective, TCM is quite limited in its capacity to provide information on multiple management alternatives. This limitation arises because sampling is generally necessary under each alternative. Although the hedonic TCM (Brown and Mendelsohn) and a generalized TCM (Smith, Desvouges, and Fisher) have been developed to circumvent the latter limitation, these approaches are themselves limited by rigid assumptions in visitation, model structure, and data requirements. A hybrid form of TCM, based on travel costs and intended behavior in response to changes in costs or site characteristics, has also been used (see Ribaudo and Epp; Ward; Teasley, Bergstrom, and Cordell; Layman, Boyce, and Criddle). Because of its hypothetical nature, however, this hybrid suffers from many of the same criticisms as contingent valuation.

The two most frequently used TCM empirical approaches are the zonal or aggregate approach and the individual approach. The zonal model (ZTCM) was the first to be developed and is still widely used (English and Bowker; Bergstrom and Cordell; Hellerstein; Richards et al.). It is based on establishing a relationship between per capita participation rates at a site from various geographic origin zones and the costs incurred in travel from the origin zone to the given site. The individual travel cost model (ITCM) is conceptually similar to the zonal model; however, the travel cost/trip relationship is based solely on individual observations. Good examples of ITCM applications in recreation include the works of Adamowicz, Fletcher, and Graham-Tomasi; Creel and Loomis; and Englin and Shonkwiler.

Arguments favoring ITCM over ZTCM include the better capability of the former to address: (*a*) statistical efficiency, (*b*) theoretical consistency in modeling individual behavior, (*c*) avoidance of arbitrary zone definitions, and (*d*) increased heterogeneity among populations within zones. In addition, statistical methods are now available for dealing with the integer nature of individual trip demand and zero truncation common to choice-based samples (Creel and Loomis; Yen and Adamowicz). Nevertheless, in defending ZTCM, Hellerstein makes the important point that truncated individual models rest on the presumption that all nonvisitors have the same demand parameters as visitors. If such is not the case, truncated individual models may be more biased than zonal models which incorporate nonvisitor information. This is an important caveat if results are intended for extrapolation to the population at large rather than to the subpopulation of users.

Data and Empirical Models

Data for the majority of recreation demand analyses are obtained via on-site sampling. While popular, this sampling format is often expensive and leaves the researcher with a sample that is both zero-truncated and usually endogenously stratified (Shaw). Alternatively, when site users and potential site users can be identified (for example, by the purchase of a hunting license), a randomly drawn mail survey allows for collection of both participant and nonparticipant information which is neither endogenously stratified nor truncated. Unfortunately, most recreation activities are without a hunting license analog.

This study falls between the two cases above. Here, a two-part sampling process is employed. First, in cooperation with America Outdoors, for each of the two rivers, a random sample of names was drawn from outfitter records comprised of those individuals who used outfitter services on that river in 1993. The quantity of names drawn was proportional to the outfitters' share of annual commercial use. For the Chatooga, 955 names were drawn, while the sample for the Nantahala consisted of 1,394 names.

Because only commercially guided rafting participants are eligible to be sampled, the data are zero-truncated. However, the probability of selection was independent of the number of trips taken, thus avoiding the problem of endogenous stratification. A six-page questionnaire eliciting information on trips, expenditures, and various socioeconomic variables was then mailed to the identified individuals. Cost constraints precluded follow-up mailings. A total of 398 surveys were returned from the Chatooga sample (for a response rate of 41.6%) and 394 from the Nantahala sample (a 28.3% response rate). Of these, there were 369 and 376 usable questionnaires for the Chatooga and Nantahala, respectively.

The individual travel cost demand model can be generally specified as follows:

$$(1)\quad TRIPS_i = g(TCOST_i, INC_i, SUB_i, OTH_i) + u_i,$$

where, for the *i*th demand unit, *TRIPS* is the quantity demanded, *TCOST* is the travel cost per trip, *INC* is the budget constraint, *SUB* is the price of an alternative site, *OTH* represents a vector including other relevant variables (e.g., other socioeconomic and site attributes), and *u* is random disturbance.

Depending on the type of recreation activity, the definition of a trip may vary. Usually, the unit of observation is the individual, and hence trips by individuals are combined with individual travel costs, income, and other variables to estimate a demand model. Such a structure works well for situations where participation and costs are individual in nature and individuals can be clearly targeted in the sampling. Examples could include activities like hunting, fly fishing, or hiking.

An alternative is to target households as the demand unit. This approach is useful for situations where a unit of supply (e.g., a campsite) can be jointly consumed by a group or family without individual price discrimination. However, for guided rafting, defining trips solely on a per household basis can be misleading. For example, a trip for a household of two would result in the consumption of two spaces in a raft, whereas a household of six would consume six spaces.

In this study, we propose an alternative dependent variable construct. While we sample households, we define the unit of consumption, a person-trip, as taking a place in the guided raft. Hence, a household wherein two members visited the site twice in a given year would have purchased four trips. Similarly, a family of four who visited the site once during the year also would have purchased four trips. This definition of the dependent variable is important for several reasons. First, both of these rivers have commercial use capacities set by the USDA/Forest Service that control the number of per person trips per year. Second, the definition helps circumvent the common empirical malady of low dispersion in the dependent variable when the activity is not likely to be repeated frequently within the relevant time frame (Ward and Loomis). Finally, the additional cost of having another person on the trip is nontrivial given that outfitter fees are a relatively large portion of per trip costs. Compare this to an activity like camping, where the use fees are per vehicle or per camp site, or where travel is the primary trip cost determinant. For these kinds of activities where there is less exclusivity and direct per person fees are minimal, a more standard trip definition may be appropriate. Alternatively, surveying only individuals could lead to an undercount of spaces purchased in the raft.

Defining trip cost in TCM models is and will continue to be a subject of debate and researcher judgments. In-transit costs may be based on respondents' reported trip costs or costs imputed from some researcher-imposed mileage rate(s). Using mileage rates reduces information needed from respondents but assumes linearity between cost and mileage. It also imposes homogeneous per mile costs in the sample which, as Randall argues, contributes to questions regarding the use of TCM to generate cardinal welfare measures. Gathering actual cost information allows for greater variability in trip cost data but affords an increased probability of response or recall bias, along with differences in what individuals perceive as costs (Ward and Loomis).

The inclusion of time costs, both in-transit and on-site, is also subject to considerable debate. Theoretically, Freeman demonstrates that both kinds of time costs should be included. However, he points out a number of problems which continue to plague applied researchers. One is the inability of a large portion of the sample to easily substitute between working increased hours at their normal (or overtime) wage rate and leisure time. Another is the possibility of utility or disutility resulting from work, travel, or on-site time, thereby rendering the full wage rate a potentially poor measure of the shadow cost of time. Freeman also notes that while most surveys elicit a pretax income measure, a more realistic wage rate would be derived from after-tax income. McConnell states that judgments about time and the cost of time have been dominated by theoretical considerations rather than empirical results, and that a measure of the cost of time may be considered "good" when it yields an "appropriate" measure of consumer surplus.

In the present study, we estimate our empirical models over a range of three time costs and two in-transit pecuniary cost measures. Hence, for each of the two rivers, six different definitions for *TCOST* are used. In the first case, reported per visit household expenses for travel were divided by the number of household participants with no time cost included. The second and third versions, based on reported costs, append a round-trip time cost to the zero time cost case, using 25% and 50%, respectively, of the household wage rate.[1] This, too, is divided by the number of participants.

Recognizing the possibility of recall bias, we calculate imputed time cost versions of the above three models wherein in-transit pecuniary costs per household visit consisted of the product of reported round-trip distance and a 9.2¢/mile variable cost factor divided by the number of household participants.[2] As they were essential to the trip, per person outfitter fees were included in all of the travel cost scenarios. However, lodging and miscellaneous items such as film or souvenirs were not included.

Because both imputed costs are based on national average vehicle operating costs and reported transportation costs, we are able to assess the congruency between these two accepted methods of assigning costs per mile in TCM studies. Oddly, the great majority of TCM studies appear to simply assign an arbitrary cost per mile, often as high as 25¢ (Englin and Shonkwiler).

---

[1] We use the common procedure of dividing annual reported pretax income by 2,000 to obtain the wage rate. As with in-transit expenses and outfitter fees, the household time cost is divided across the participants on a given visit.

[2] According to a national vehicle study performed by Runzheimer and Company of Rochester, Wisconsin, the U.S. average variable cost of operating a mid-size car in 1994 was $0.092/mile, with costs for 1994 ranging from $0.077 for compacts to $0.13 for large cars (Mateja).

Income (*INC*) was defined as annual gross household income. A binary variable, *SUB*, was used to account for substitution. The issue of substitution, whether in site- or activity-based recreation demand models, is unresolved, and choice of a substitute variable remains arbitrary. Hellerstein used an imputed substitution price based on the site nearest the destination having similar characteristics. Such an approach assumes site rather than activity substitution, and that one is headed in the general direction of the chosen site. It can as easily be argued that the substitute site should be the one closest to the individual's origin. Alternatively, Bergstrom and Cordell used a supply index based on the availability of a combination of alternative activities proximal to the individual's origin. This approach assumes activity rather than site substitution. Among the respondents in our samples, more than 50% reported that they would have stayed home or gone to work rather than substitute another site or activity. While given the opportunity, only a small proportion reported specific alternative sites. Hence, we felt a binary variable (*SUB* = 1 if respondent intends to go to another site or activity, and *SUB* = 0 otherwise) appropriate, although the substitution issue clearly merits further research.

Additional variables for the Chatooga included previous experience (*PRE*) and time on-site (*TIM*). For the Nantahala, previous experience was included, but time on-site was left out because of the uniformity of the trip length in the sample. Finally, both specifications included a variable (*OSITE*) to account for visiting other sites provided that rafting was the primary purpose for the trip.

The individual travel cost models were estimated using truncated Poisson (TP) and truncated negative binomial (TNB) estimators, as described in Creel and Loomis or in Yen and Adamowicz. These estimators are increasingly used in recreation demand research because of their ability to address the integer nature of trips and to correct for zero truncation (Englin and Shonkwiler). The TP density for each of N independent individuals in a sample is

$$(2)\qquad f(Y_i = y_i \mid Y_i > 0) = \frac{\exp(-\lambda_i)\lambda_i^{y_i}}{y_i![1 - \exp(-\lambda_i)]},$$

$$y_i = 1, 2, \ldots, \qquad i = 1, 2, \ldots, N,$$

where Y_i is a discrete random variable for trips and y_i is the realized integer value. The location parameter, λ_i, is conventionally parameterized as an exponential function of a vector of independent variables, $\lambda_i = \exp(x_i\beta)$, allowing a regression model to be estimated by maximum likelihood. The likelihood function for the TP is

$$(3)\qquad \ln L = \sum_{i=1}^{n} [-\lambda_i + y_i x_i\beta - \ln(y_i!) - \ln(1 - \exp(-\lambda_i))].$$

Analogously, for the TNB, the density and log-likelihood functions are, respectively,

$$(4)\qquad f(Y_i = y_i \mid Y_i > 0) = \frac{\Gamma\left(\frac{1}{\alpha} + y_i\right)}{\Gamma\left(\frac{1}{\alpha}\right)\Gamma(y_i + 1)} \cdot \frac{(\alpha\lambda_i)^{y_i}(1 + \alpha\lambda_i)^{-(1/\alpha + y)}}{1 - (1 + \alpha\lambda_i)^{-(1/\alpha)}},$$

$$y_i = 1, 2, \ldots, i = 1, 2, \ldots, N; \alpha > 0,$$

and

$$(5)\qquad \ln L = \sum_{i=1}^{n} \Bigg[\ln \Gamma\left(\frac{1}{\alpha} + y_i\right) - \ln \Gamma(y_i + 1) - \ln \Gamma\left(\frac{1}{\alpha}\right) + y_i \ln(\alpha) + y_i x_i\beta - \left(\frac{1}{\alpha} + y_i\right)\ln(1 + \alpha\lambda_i) - \ln(1 - (1 + \alpha\lambda_i)^{-(1/\alpha)})\Bigg],$$

where $\Gamma(\cdot)$ represents the gamma function.

The original sample was trimmed according to two popular conventions to include only

Table 1. Truncated Negative Binomial (TNB) Parameter Estimates for the Chatooga River (dependent variable = annual person trips/household)

	Reported Costs			Imputed Costs			
Variable	0% Wage	25% Wage	50% Wage	0% Wage	25% Wage	50% Wage	Mean
CONSTANT	.9232	.6624	.5365	.9964	.8761	.7356	1
	(4.732)*	(3.453)	(2.839)	(5.271)	(4.839)	(4.096)	
TCOST	−.0072	−.0052	−.0035	−.0084	−.0055	−.0037	
	(5.972)	(7.117)	(7.910)	(8.098)	(8.133)	(8.709)	
INC	.0034	.0065	.0074	.0039	.0056	.0064	61.47
	(1.442)	(2.789)	(3.280)	(1.676)	(2.473)	(2.882)	
SUB	−.0089	−.0736	−.0682	−.1156	−.1362	−.1274	.5381
	(.6980)	(.5830)	(.5470)	(.9340)	(1.095)	(1.030)	
TIM	.3502	.4031	.3702	.4717	.3900	.3599	.4763
	(3.849)	(4.240)	(3.873)	(5.046)	(4.234)	(3.837)	
PRE	.5034	.6111	.6120	.5709	.5952	.5941	.4843
	(3.580)	(4.421)	(4.516)	(4.165)	(4.391)	(4.414)	
OSITE	.4180	.4369	.4455	.4398	.4842	.4819	.3498
	(3.138)	(3.290)	(3.415)	(3.361)	(3.695)	(3.712)	
alpha	.3392	.2884	.2785	.2758	.2625	.2649	
	(3.571)	(3.081)	(2.995)	(3.353)	(3.027)	(2.962)	
N	250	250	250	250	250	250	
Likelihood Ratio	203.8	221.5	222.2	225.84	232.6	228.84	
E (CS/trip)	$139.56	$192.66	$286.22	$119.16	$181.00	$270.94	
90% Lower	$101.24	$148.27	$226.88	$95.29	$144.50	$219.17	
90% Upper	$177.89	$237.03	$345.57	$143.29	$217.50	$320.85	
Mean *TCOST*	$103.34	$157.45	$213.30	$117.00	$171.40	$227.25	

* Numbers in parentheses are *t*-values.

Notes: Reported models for the Chatooga use a market radius of 1,000 miles one way. Additional models were estimated using radii of 500 miles and no limit. Approximately 1% of the respondents sampled traveled from outside the 1,000-mile radius. The results are within 10% for all models except the zero time cost 500-mile case, which has an expected per person-trip consumer surplus approximately 24% higher than either the 1,000-mile or the no-limit alternatives.

those visitors within a 1,000-mile radius of each river (over 95% of respondents). This action follows Hellerstein and others, and is based primarily on the premise of avoiding visitors on long multipurpose trips. In addition, respondents indicating that guided rafting at this river was not the main reason for their trip were omitted, as it is unreasonable to attribute travel costs to a site or activity which is not the primary reason for making the trip.

Results

Results for the Chatooga River are reported in table 1. Both truncated Poisson and truncated negative binomial models were estimated. Only the TNB models are reported because the hypothesis of no overdispersion was rejected based on a Wald test equivalent to the asymptotic *t*-ratio on the estimated dispersion parameter (Yen and Adamowicz). Means for all explanatory variables also are listed.

Signs on all of the estimated coefficients for the explanatory variables coincide with theoretical expectations. All of the regressors are significant based on their asymptotic *t*-ratios. The substitute sign is negative, which means that people who indicated they would go elsewhere have a lower ceteris paribus demand for trips on the Chatooga.

In comparing similar models with different price constructs, it is interesting to note that the price coefficients based on reported transportation and outfitter expenses are close to

Table 2. Truncated Negative Binomial (TNB) Parameter Estimates for the Nantahala River (dependent variable = annual person trips/household)

	Reported Costs			Imputed Costs			
Variable	0% Wage	25% Wage	50% Wage	0% Wage	25% Wage	50% Wage	Mean
CONSTANT	.8580	.9294	.8503	1.193	1.067	.9334	1
	(2.597)*	(3.248)	(3.094)	(3.619)	(3.735)	(3.395)	
TCOST	−.0075	−.0073	−.0052	−.0112	−.0080	−.0055	
	(2.514)	(4.934)	(5.403)	(4.345)	(5.760)	(5.862)	
INC	.0086	.0106	.0118	.0074	.0101	.0115	58.23
	(2.580)	(3.776)	(4.384)	(2.304)	(3.810)	(4.435)	
SUB	−.1571	−.1324	−.1275	−.1557	−.1343	−.1292	.6181
	(.9500)	(.8590)	(.8460)	(.9820)	(.9030)	(.8770)	
PRE	.5661	.5532	.5546	.5263	.5355	.5436	.4931
	(3.486)	(3.584)	(3.591)	(3.329)	(3.532)	(3.559)	
OSITE	.0742	.1125	.1177	.0870	.1206	.1229	.3959
	(.5170)	(.8200)	(.858)	(.6410)	(.9120)	(.9160)	
alpha	.4413	.3520	.3395	.3601	.3095	.3130	
	(3.753)	(3.749)	(3.774)	(3.687)	(3.662)	(3.712)	
N	163	163	163	163	163	163	
Likelihood Ratio	197.5	205.7	209.1	207.8	212.8	213.8	
E (CS/trip)	$133.73	$136.91	$191.29	$89.03	$124.70	$182.50	
90% Lower	$46.50	$91.41	$133.22	$55.43	$89.20	$131.44	
90% Upper	$222.95	$182.42	$249.36	$122.64	$160.21	$233.56	
Mean *TCOST*	$43.62	$73.75	$103.85	$51.31	$81.29	$111.39	

* Numbers in parentheses are *t*-values.

Notes: Reported models for the Nantahala use a market radius of 1,000 miles one way. Additional models were estimated using radii of 500 miles and no limit. Approximately 1% of the respondents sampled traveled from outside the 1,000-mile radius. The expected per trip consumer surplus estimates are uniformly lower for the 500-mile case than either the 1,000-mile or the no-limit alternatives by approximately 18% to 25%.

their counterparts based on the constructed price models. This suggests that the assigned price of 9.2¢ per mile appears to be in line with reported variable travel expenses. This price is on the low end of the range used in the literature, which could well mean that results derived from higher mileage rates should be viewed with some caution.

Nantahala River results are reported in table 2. In general, the pattern of results is similar to that for the Chatooga River. One noticeable difference is that the price coefficients are larger across the board, indicating a greater price responsiveness for the Nantahala.

Per trip consumer surplus (CS) was estimated and is reported for each model and river combination at the bottoms of tables 1 and 2. Under the restrictions of the above count data models, per trip consumer surplus for the sample as well as for each individual is calculated as $(-1/B_{tc})$, where B_{tc} is the parameter estimate on the travel cost variable. In addition, for each model, 90% confidence intervals are reported, based on the method of statistical differentials (Yen and Adamowicz), sample size, average travel cost, and likelihood ratio statistics.

The per trip surpluses are inversely proportional to the responsiveness of the models to price changes. Our models indicate point estimates for the per trip economic surplus of guided whitewater rafting on the Chatooga River between $119 and $286, depending mainly upon the level at which imputed travel time cost is included. The difference in mean consumer surplus per trip for both reported cost and imputed cost models varies dramatically for the time cost specification. Wage proportions used in this study bracket the majority of those reported in the literature and clearly demonstrate how sensitive consumer surplus estimates can be to assumptions about the inclusion of time.

For the Nantahala, the pattern of results again is similar. The point estimates of surplus values range from $89 to $191. Under each of the assumed models, the Chatooga per trip surplus exceeds that of the Nantahala by 4 to 49%, with five of six estimates falling between 34 and 49%. This difference seems reasonable when one considers the higher quality and better rapids on the Chatooga. Similar relationships between river quality and surplus were found by Sanders, Walsh, and McKean, and by Boyle, Welsh, and Bishop.

Discussion

For both rivers, the biggest difference in point estimates results from the level at which to include time cost, especially in the models where transportation costs are perfectly linear with distance traveled. While the time issue is still unresolved in the TCM literature (McKean, Johnson, and Walsh), we feel it is prudent to report results with and without estimated time costs so as to demonstrate the sensitivity of surplus estimates to a range of researcher-imposed judgments. For both of these rivers, it appears that consumer surplus estimates increase more than proportionally to wage fraction increases. It is unlikely that such volatility is unique to this study. Clearly, more research is necessary to address this issue, and there is probably no reason to expect a solution generalizable across the myriad of recreation demand applications. Perhaps one alternative which merits exploration is to include more qualitative dimensions in the TCM approach analogous to focus groups and debriefing in contingent valuation studies.

We also suggest that where possible, researchers should estimate and present results using both reported and imputed transportation costs. Such a procedure provides a useful comparison and a guide for research situations wherein reported expenses are unavailable. Too often, one mileage rate is subjectively chosen and one set of surplus estimates is derived and reported, leaving readers with no feel for the impacts of researcher judgments. Here, we favor the reported costs. While recall accuracy may be questioned, we think it reasonable to expect people to behave according to what they perceive their costs to be rather than according to an assumed linear distance function where all visitors have the same cost per mile. Nevertheless, such a hypothesis can be tested only in a controlled setting and should be a priority for future research.

Compared to other studies, our estimated values appear quite plausible. For example, in a Colorado study, Sanders, Walsh, and McKean found an average recreation trip consumer surplus across 11 high-quality rivers to be about $63 (1983 dollars, or $91 in 1994 dollars) using a participation weighted individual travel cost model. They also found a Hicksian surplus per trip of $66 (or $95 in 1994 dollars) using open-ended contingent valuation methods. Their results were not restricted to guided whitewater trips. Boyle, Welsh, and Bishop used dichotomous choice contingent valuation to value whitewater boating on the Colorado River running through the Grand Canyon and found a range of surplus values per trip for commercial passengers from $127 to $888 (1987 dollars, or $159 to $1,113 in 1994 dollars).

It is fairly evident that southern rivers like the Chatooga and Nantahala provide a considerable amount of surplus value to participants in guided whitewater rafting. In fact, this may be among the most highly valued forms of outdoor recreation with large participation rates. Like previous studies in other regions, we find that surplus and river quality (here we mean intensity and trip length) are directly related and that per trip consumer's surplus can approach $300 depending on travel cost assumptions. However, unlike previous studies, our samples are not endogenously stratified and we account for truncation in our estimation.

Finally, our results should be interpreted with some caution for a number of reasons. First, by using the truncated count data models, we assume that the parametric relationship estimated for participants holds for nonparticipants. This of course cannot be validated without nonparticipant information which, in situations like the present, is virtually impossible to obtain. In the only case we know of where an empirical test was done (Yen and Adamowicz), the authors found that inclusion of nonparticipant information and subsequent estimation with an untruncated model resulted in significantly lower consumer surplus estimates. While the Yen and Adamowicz findings could imply that our estimates are possibly high, there simply isn't sufficient evidence from one empirical trial to make any sound conclusions. However, their findings show that in the absence of nonparticipant information, the truncated count estimators performed better than any alternatives.

We should also note that our estimates are limited to users who likely have the highest values for the sites. This results from following convention and trimming our sample to include only those respondents listing guided whitewater rafting at the chosen river to be the primary purpose of their trip. For the Chatooga, this meant deleting 19% of the respondents, and for the Nantahala, 36% were deleted. While our estimates represent the largest group of users in both cases, any type of meaningful aggregation would have to account for the nonprimary purpose participants. One alternative would be to obtain information on costs and distances necessary to deviate from the main destination in order to participate on the guided rafting trip and attempt a pooled model. Alternatively, a conservative lower bound for aggregation would, of course, be zero.

References

Adamowicz, W.L., J.J. Fletcher, and T. Graham-Tomasi. "Functional Form and the Statistical Properties of Welfare Measures." *Amer. J. Agr. Econ.* 71(1989):414–21.

Bergstrom, J.B., and H.K. Cordell. "An Analysis of the Demand for and Value of Outdoor Recreation in the United States." *J. Leisure Res.* 23(1991):67–86.

Boyle, K.J., M.P. Welsh, and R.C. Bishop. "The Role of Question Order and Respondent Experience in Contingent Valuation Studies." *J. Environ. Econ. and Manage.* 25(1993):S80–S99.

Brown, G., and R. Mendelsohn. "The Hedonic Travel Cost Method." *Rev. Econ. and Statis.* 66(1984):427–33.

Creel, M.D., and J.B. Loomis. "Theoretical and Empirical Advantages of Truncated Count Data Estimators for Analysis of Deer Hunting in California." *Amer. J. Agr. Econ.* 72(1990):434–41.

Englin, J., and J.S. Shonkwiler. "Estimating Social Welfare Using Count Data Models: An Application to Long-Run Recreation Demand Under Conditions of Endogenous Stratification and Truncation." *Rev. Econ. and Statis.* 77(1995):104–12.

English, D.B.K., and J.M. Bowker. "Sensitivity of Whitewater Rafting Consumer's Surplus to Pecuniary Travel Cost Specifications." *J. Environ. Manage.* 47(1996):79–91.

Fletcher, J.J., W.L. Adamowicz, and T. Graham-Tomasi. "The Travel Cost Model of Recreation Demand: Theoretical and Empirical Issues." *Leisure Sci.* 12(1990):119–47.

Freeman, A.M. *The Measurement of Environmental and Resource Values: Theory and Methods.* Washington DC: Resources for the Future, 1993.

Hellerstein, D. "Using Count Data Models in Travel Cost Analysis with Aggregate Data." *Amer. J. Agr. Econ.* 73(1991):660–66.

Layman, R.D., J.R. Boyce, and K.R. Criddle. "Economic Valuation of the Chinook Salmon Sport Fishery of the Gulkana River, Alaska, Under Current and Alternate Management Plans." *Land Econ.* 72(1996):113–28.

Mateja, J. "National Vehicle Study Shows Rising Price of Hitting the Road." *Athens* [Georgia] *Banner-Herald* (14 April 1995):20. AP Wire Service, *Chicago Tribune.*

McConnell, K.E. "Model Building and Judgment: Implications for Benefit Transfers with Travel Cost Models." *Water Resour. Res.* 28,3(1992):695–700.

McKean, J.R., D.M. Johnson, and R.G. Walsh. "Valuing Time in Travel Cost Demand Analysis: An Empirical Investigation." *Land Econ.* 71(1995):96–105.

Randall, A. "A Difficulty with the Travel Cost Method." *Land Econ.* 70(1994):88–96.

Ribaudo, M.O., and D.J. Epp. "The Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality." *Land Econ.* 60(1984):397–403.

Richards, M.T., D.A. King, T.C. Daniel, and T.C. Brown. "The Lack of an Expected Relationship

Between Travel Cost and Contingent Value Estimates of Forest Recreation Value." *Leisure Sci.* 12(1990):303–19.

Sanders, L.D., R.G. Walsh, and J.R. McKean. "Comparable Estimates of the Recreation Value of Rivers." *Water Resour. Res.* 27(1991):1387–94.

Shaw, D. "On-Site Samples' Regression: Problems of Nonnegative Integers, Truncation, and Endogenous Stratification." *J. Econometrics* 37(1988):211–23.

Smith, V.K. "Taking Stock of Progress with Travel Cost Recreation Demand Methods: Theory and Implementation." *Marine Resour. Econ.* 6(1989):279–310.

Smith, V.K., W.H. Desvouges, and A. Fisher. "A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits." *Amer. J. Agr. Econ.* 68(1986):280–90.

Teasley, J., J.C. Bergstrom, and H.K. Cordell. "Estimating Revenue Capture Potential Associated with Public Area Recreation." *J. Agr. and Resour. Econ.* 19(1994):89–101.

U.S. Water Resources Council. *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.* Washington DC: Government Printing Office, 1983.

Ward, F.A. "Economics of Water Allocation to Instream Uses in a Fully Appropriated River Basin: Evidence from a New Mexico Wild River." *Water Resour. Res.* 23(1987):381–92.

Ward, F.A., and J.B. Loomis. "The Travel Cost Demand Model as an Environmental Policy Assessment Tool: A Review of Literature." *West. J. Agr. Econ.* 11(1986):164–78.

Yen, S.T., and W.L. Adamowicz. "Statistical Properties of Welfare Measures from Count-Data Models of Recreation Demand." *Rev. Agr. Econ.* 15(1993):203–15.