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AN ALTERNATIVE TECHNIQUE FOR ESTIMATING THE DEMAND FOR RIVER OUTFITTER SERVICES

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ABSTRACT

A common method for deciding among available resource allocation options is to examine relative magnitudes of consumer surplus. Consumer surplus estimates for marketed commodities are normally accomplished by econometrically estimating the demand curve for a typical individual and calculating the area underneath that curve. However, for outfitted river trips, the small number of annual trips taken by most households leads to nonsignificant price coefficients. This paper presents an alternative technique for estimating of consumer's surplus for users of river outfitters, treating trip costs as prices. First, annual household demand curves for a sample of river outfitter clients are calculated. These demands are horizontally aggregated into a market demand curve. Fitting a constant elasticity curve to the market demand for the Chattooga and Nantahala Rivers shows demand to be price elastic. Mean annual household surplus estimates range from $303 to $1,856 depending on the river and estimation method. Possible improvements to this alternative method are also discussed.

INTRODUCTION

Comparing changes in net economic benefits across available alternatives is often an important criterion in resource allocation decisions (Randall 1987). There are indications that one such class of decisions that is increasing in importance relates to instream water uses, especially in recreationally significant rivers (Ward 1987). Competing demands for water, including for recreation, hydropower, irrigation, and domestic consumption uses are becoming more common throughout the U.S.

Travel Cost Modeling (TCM) is one of two primary methods used to estimate such benefits (Ward and Loomis 1986). TCM results in measures of ordinary (Marshallian) consumer surplus, rather than the exact Hicksian measures. However, for estimating surplus measures for trips to a given recreation site, the Marshallian measures may be adequate, since the differences between the two welfare measures are likely to be small (Hellerstein 1992, Alston and Larson 1993).

Our goal was to estimate consumer surplus measures for users of commercial outfitters on the Chattooga and Nantahala Rivers. We expected that many of the surveyed households might take only a few trips to these rivers over the course of the year. This problem has been noted as a significant drawback in other individual TCM studies (Ward and Loomis 1986). Accordingly, we developed an alternative method to estimate demand for outfitted trips to these rivers, that was based on the individual TCM price and quantity data. This paper reports on that method and its results.

METHODS

Data

This study was conducted in cooperation with America Outdoors, a national outfitter and guide organization. A random sample of individual clients of member outfitters on the Chattooga and Nantahala Rivers were selected by the outfitter organization. These individuals received a mail survey not more than two months after using guide services in 1993. Trip-related data collected included trip length, miles and hours traveled, and detailed trip expenditures, for items such as lodging, gasoline, air fares, food, souvenirs, and outfitter fees. Annual river use information included the number of total river recreation trips and outfitter use to other rivers in the past year.

Other questions asked about the number of outfitted trips to the targeted river and the average outfitter price paid on those trips. These were asked with reference to each of the two primary types of trips that outfitters offer for that river. For the Chattooga River, outfitters offer one-day and two-day guided trips. For the Nantahala, outfitters offer guided and unguided trips. These distinctions were made primarily due to time and cost differences between the trip types. For each river, number of trips and average prices for the each of the trip types were obtained. However, only a few respondents indicated taking two-day trips on the Chattooga, so all observations were combined in to one demand model for the Chattooga.

In addition, just after asking about use of that river and the average outfitter prices paid, each survey contained one of four change scenarios for outfitter prices. Half of the mailed surveys gave a price increase, and half a price decrease. Half gave a ten percent change from the average outfitter prices for that river, and half gave a 20 percent change from the average outfitter price. For example, the average outfitter fee on the Chattooga River was $70 for day trips and $140 for overnight trips. The possible price change questions were: "Now suppose that the average outfitter fee had been $5 ($10) higher (lower) for day trips and $15 ($30) higher (lower) for overnight trips. How many trips of each type do you think you would have taken in the past 12 months?"

Individual TC Models

Annual recreation trips to the river per household was the dependent variable selected for our study. Independent variables for the individual TCM analysis included household income, out-of-pocket trip costs, trip length in days, number of trips to other rivers, and dummy variables for local residents, business trip users, and substitute activity choice. Four functional forms were estimated: linear, log-linear, linear-log, and double log.

No significant trip price coefficients resulted for any of the functional specifications across any of the three river models (Table 1). Most households take only one or two trips per year. For guided trips on both rivers, at least 85 percent of households reported taking only 1 trip to the river in the past 12 months. Two-thirds of households taking unguided trips on the Nantahala took only one trip in the last year. This lack of dispersion in the dependent variable undoubtedly affected the price coefficient estimates. If the results from these analyses were taken at face value, one might infer that demand was price inelastic, and possibly come up with incorrectly high consumer surplus estimates.

Table 1. Results for Price Coefficients from Individual TC Models

Model Form		River, Trip Type		
		Chattooga, All Types	Nantahala, Guided	Nantahala, Unguided
Linear:	Beta	-0.00005	0.00001	-0.00016
	(t)	(-0.651)	(0.077)	(-0.289)
Lin-Log:	Beta	-0.0108	0.000003	-0.00017
	(t)	(-0.298)	(0.109)	(-0.834)
Log-Lin:	Beta	-0.00001	0.0426	-0.1114
	(t)	(-0.315)	(1.031)	(-0.718)
Log-Log:	Beta	-0.0010	0.0212	-0.0539
	(t)	(-0.054)	(1.182)	(-0.953)

Alternative Method

The household's actual cash costs for the trip and annual use level represent one point on the household's demand curve for that river. A second point on the demand curve was obtained from the hypothetical outfitter price change scenario. The price value for this point equalled the actual cash price plus the product of the number of people in the group and the per individual price change. Quantity was given by the household's response to the trips it would have taken given this price change.

Not all households indicated that the changes in outfitter prices would result in their taking a different number of trips. For those households who took guided trips on both the Nantahala and Chattooga Rivers, slightly more than forty percent indicated that they would change their quantity of trips in response to changes in outfitter prices. For those who took unguided trips on the Nantahala, the figure was just under sixty percent.

For the households that would change trip quantities given price changes, individual demand curves were assumed to be linear. Demand curves for households whose quantity did not change were only slightly more difficult to obtain. Let P_1 be the higher of the actual price and the price including the hypothesized outfitter price change, let P_2 be the lower of the two, and let P_m be the maximum observed actual price paid across these households. The trip demand function for these households was assumed to be perfectly inelastic below P_1, and linear above P_1, with a choke price of P_m (Figure 1).

Given these at least piecewise linear demand functions, it was straightforward to calculate both annual consumer surplus for each household, and the quantity of trips a household would take at various prices. Quantities were summed across all households in the sample. The resulting market demand curves were approximated using both a linear and constant elasticity (double- log) specifications.

RESULTS

For all three models, the market demand curve was best approximated by the CES function (Table 2 and Figures 2-4). Also for all three models, the price coefficients in the CES models indicated that market demand was everywhere elastic. This is in sharp contrast to the results from the individual TC models presented earlier.

Table 2. Results of Estimation of Sample Market Demand, CES Demand

	Chattooga All Types	Nantahala, Guided	Nantahala, Unguided
Intercept	17.496	13.157	12.37
(t)	(9.25)	(8.72)	(9.35)
Price	-1.806	-1.127	-1.347
(t)	(-6.33)	(-5.59)	(-5.95)
Model F	40.06	31.24	35.38

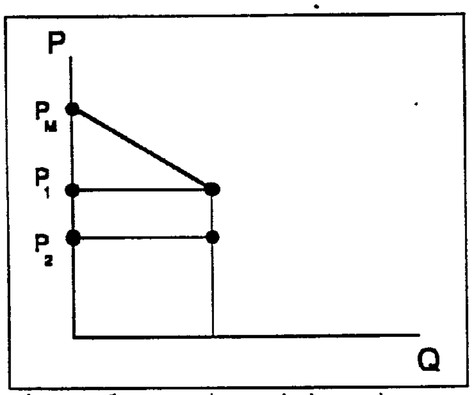

Figure 1. Estimated demand curve for inelastic demander

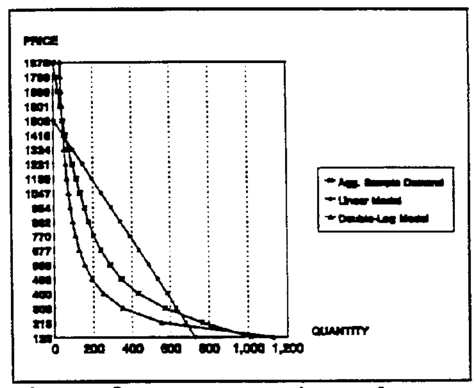

Figure 2. Aggregated sample demand and fitted models for the Nantahala River - guided trips

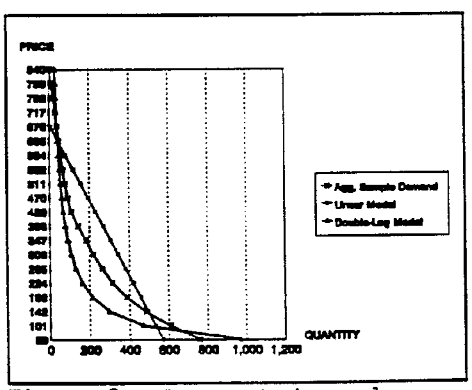

Figure 3. Aggregated sample demand and fitted models for the Nantahala River - unguided trips

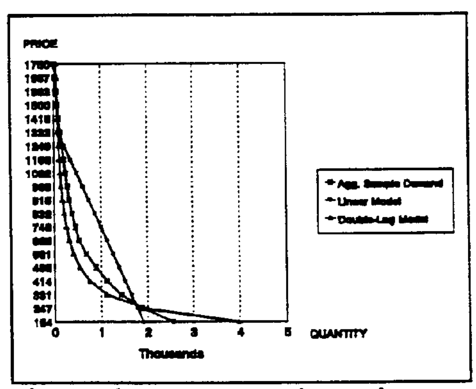

Figure 4. Aggregated sample demand and fitted models for the Chattooga River

We now had three methods from which to calculate a consumer surplus measure. First, we could estimate annual household surplus from the individual TCM models. Since these models indicated an inelastic demand, we needed to determine a choke price. Following Adamowicz, Fletcher, and Graham-Tomasi (1989), we used the maximum price observed in the sample. Second, we could average the individual household surplus, from the individual demand curves. Third, we could calculate surplus from the estimated sample market demand curve.

The results for average annual household surplus were lowest for the averaged individual demands, ranging from just over $303 for unguided trips to the Nantahala to $688 for guided trips on the Nantahala (Table 3). The largest surpluses were, not surprisingly, from the individual TC models. These values were three times larger than the averaged individual surpluses. Surplus estimates from the fitted market demand model were somewhat higher than the individual demand averages.

Table 3. CS Comparison for Annual Household Surplus

Method	River/Type		
	Chattooga	Nantahala, Guided	Nantahala, Unguided
Individual Demand Curve Average: $(^1/_N)\ (\sum_{i=1}^{N} CS_i)$	511.71	688.20	303.44
Double Log Model: $(^1/_N)\ (\frac{e^x}{B+1})\ (P_c^{B+1} - \bar{P}^{B+1})$	882.55	742.49	422.55
Standard Method: $(\bar{Q} * (P_c - \bar{P}))$	1,654.55	1,856.20	988.17

When the surplus measure are calculated on a per person per trip basis, the fitted market demand curve yielded the lowest estimates, ranging from about $73 for unguided trips on the Nantahala to just over $200 for Guided trips on the Nantahala (Table 4). The individual demand averages were somewhat higher, ranging from about $115 for unguided trips on the Nantahala, to slightly under $300 for guided trips on the Nantahala. Again, the surplus estimates form the individual TC models were substantially higher than the other estimates.

Table 4. CS Comparison for Per Person Per Trip Surplus

Method	River/Type		
	Chattooga	Nantahala, Guided	Nantahala, Unguided
Individual Demand Curve Average: $(^1/_N) \sum_{i=1}^{N} (\frac{CS_i}{\#Trips_i * HHSize_i})$	246.58	298.84	115.33
Double Log Model: $(\frac{CS}{\overline{Trips} * \overline{HHSize}})$	190.50	208.03	73.42
Standard Method: $(\frac{CS}{\overline{Trips} * \overline{HHSize}})$	615.94	561.09	239.10

DISCUSSION

This paper has presented an alternative method for estimating recreation demand curves for forest resources. It develops demand curves from actual price and quantity data and hypothetical data whose prices are based on clearly defined changes from the actual prices faced by the households. The empirical application of the method yields annual consumer surplus estimates that seem intuitively reasonable, and comparable to other studies. For example, in a study of a whitewater river in New Mexico, Ward (1987) obtained annual surplus estimates for boating activity of between $1,000 and $2,000, using the TCM. It would seem that this alternative method may be especially valuable for applications to resources that households visit only a few times annually. In these cases, a lack of dispersion in the quantity variable may incorrectly be interpreted as a highly inelastic demand.

Future research can address several issues regarding further developments of this method. First, our price variable included all recreation trip costs, not just travel and activity related costs. To the extent that the other costs, such as food or souvenirs, simply shift all prices upward, there should be no effect on surplus estimates. However, it would be useful to test the robustness of the estimates to inclusion of these other trip costs.

Second, confidence intervals should be calculated for both the averaged individual demands and the fitted market demand. Recent work by Kling (1991) would provide an excellent beginning point. It may be that the inclusion or exclusion of some trip expenditures may have greater effects on confidence intervals than on the estimates themselves.

A third area would be to examine a method for estimating individual choke prices for households whose demand was inelastic with respect to our hypothesized price changes. We assumed that all of these households had a choke price equal to the maximum price observed in this portion of the sample. Undoubtedly, this affected our surplus estimates (Hellerstein 1992).

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