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BENEFITS TRANSFER AND COUNT DATA TRAVEL COST MODELS: AN APPLICATION AND TEST OF A VARYING PARAMETER APPROACH WITH GUIDED WHITEWATER RAFTING

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ABSTRACT---

We combine currently popular count data methods with earlier work by Vaughan and Russell on varying parameter travel cost models to model trip demand and calculate consumer surplus. We test and reject the hypothesis that per trip consumer surplus from guided rafting is invariant to river characteristics. We then develop and test a series of benefit transfer functions against benefits derived from individual river models. Our findings suggest that this flexible form of count data model offers considerable promise as a benefit transfer function.

-----KEY WORDS-----

benefits transfer, whitewater rafting, travel cost, count data models, varying parameters

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Introduction

Benefit-cost analysis, both formal and informal, is being increasingly used as a policy tool in public land management. This use is heightened by public support for multiple use policies which often include allocation trade-offs between market and nonmarket outputs. Unfortunately, the time and money costs of obtaining primary data are increasing rapidly as well. Correspondingly, the need to transfer benefits estimate results from study sites to policy sites has become an important problem for applied economists and policy makers. This need has historically been met by extrapolation across 'similar' sites and 'professional' judgements (Boyle and Bergstrom 1992).

Recently, somewhat more structured approaches to benefits transfer in the form of benefit functions have been explored by applied economists. The basic idea is that a demand or benefit function estimated in one setting or activity/setting combination can be used or "transferred" to an alternative setting. Parameters estimated at the original site are then combined with exogenous variable values from the target site to obtain the necessary economic surplus or benefits estimates. Empirical assessments of benefits transfers in recreation settings have included studies addressing spatial and temporal transferability[1] using contingent valuation (CV) and/or travel cost (TC) methods. Loomis (1992), referencing some earlier transfer function discussion from the seventies, examined spatial transferability using zonal TC models for salmon and steelhead fishing in the Pacific Northwest. Based on Chow tests of model coefficient equality, he found that functions could be successfully transferred within a state but for these activities and locations, interstate transferability was questionable. In another study testing the transferability of regional water recreation demand models using more sophisticated zonal TC models, Loomis et al. (1995) found that regional model transfer was not statistically viable. However, they did find sufficient similarity among price coefficients in a subset of the models to suggest that while the prospects of function transfer to determine total use and total benefits appeared bleak, more limited transfer focusing on average benefit per day (or per trip) appeared promising.

Downing (1992) and Downing and Ozuna (1996) examined benefits function transfer both spatially and intertemporally. Their study involved both CV and individual TC models of recreational angling at eight adjacent bays along the Texas coast. They assessed function transfer feasibility across bays and across time periods for annual benefits using CV and per trip benefits using TC. They concluded that benefits function transfer tended to overestimate benefits and was generally not reliable.

In this paper we examine benefits transfer functions for guided whitewater rafting at five geographically dispersed sites. Our main objective is to develop and statistically test a transferable individual TC whitewater rafting trip demand model. A primary contribution of the paper is that we combine the varying parameter travel cost concept of Vaughan and Russell (1982) with the currently popular individual count data TC modeling framework. In doing so, we demonstrate a variant of the count data model with the enhanced flexibility to allow consumer surpluses to vary with site characteristics in a pooled model. Additionally, we feel our results add significantly to the rather small collection of published consumer surplus estimates for guided whitewater rafting.

Data and Methods

The rivers examined in this study cover a wide range of trip length, difficulty, and market area (Table 1). The Nantahala River offers a short trip suitable for novices and families. At the other extreme, the Gauley requires substantial previous rafting experience, and the Middle Fork significant time and money requirements (Armstead 1989). The Chattooga and the Middle Fork are part of the designated National Wild and Scenic River System, and have limits on annual commercial use and staggered start times for rafting groups. Rafting on the other three rivers depends on dam releases. The Gauley and Middle Fork are two of an elite class of whitewater rafting opportunities (Armstead 1989). Extremely challenging rapids, and very remote location separate these two from the other three rivers. In contrast, the Nantahala is a low-end introduction to the sport accessible to both adults and children; typical trips are short, inexpensive, relatively tame, and usually crowded. The Chattooga and the Kennebec fall in the middle, offering challenging trips to a regional audience.

The data for each of the five rivers were gathered in a two-part process. On each river a random sample of names were drawn from outfitter records of those people who used outfitter services on that river in 1993. Because only 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 6-page questionnaire eliciting information on trips, expenditures, and various socioeconomic variables was then mailed to the identified individuals. Raw response rates for the rivers ranged from 28% to 46%. Usable samples for each river ranged from 293 to 443 observations with a total of 1583 collectively.

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 visiting the site once a year would also purchase four trips. This definition of the dependent variable is important for several reasons. First, several of these rivers have commercial use capacities set by the USDA Forest Service that control the number of per-person trips per year. Second, it 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, 1986). 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.

Our theoretical and empirical models follow previously published individual travel cost methods using count data distributions (see for example, Creel and Loomis 1990, Yen and Adamowicz 1993, Englin and Shonkwiler 1995). Because the data are zero truncated we estimate with both truncated Poisson and truncated negative binomial specifications. Explanatory variables for each river included travel, outfitter, and time costs (*TCOST)*, income (*INC)*, time on site *(TIM)*, previous experience (*PRE)*, and binary variables for other site visits on the trip (*OSITE)* and substitution (*SUBS)*.[2] Following Layman et al. (1996) we examine the models over a range of mileage and time cost assumptions for the travel cost variable.[3]

Our approach with the pooled models differs from previous work with count data models, however, in that we follow the lead of Vaughan and Russell (1982) and include these characteristic variables as interactions with travel cost thus allowing price response to vary with site characteristics. Each pooled model includes two new variables to distinguish salient features, namely, wild and scenic river designation (*WS*) and floated distance (*FLT*). Hence for the truncated negative binomial specification, the density and loglikelihood functions are, respectively:

$$f(Y_i{=}y_i \mid Y_i{>}0) \;=\; \frac{\Gamma(\frac{1}{\alpha}+y_i)}{\Gamma(\frac{1}{\alpha})\Gamma(y_i+1)} \;*\; \frac{(\alpha\lambda_i)^{y_i}\;(1+\alpha\lambda_i)^{-(1/\alpha+y_i)}}{1-(1+\alpha\lambda_i)^{-(1/\alpha)},} \tag{1}$$

$$y_i \;=\; 1,2,\ldots, \qquad i \;=\; 1,2,\ldots,n,\;\; \alpha{>}0;$$

$$lnL \;=\; \sum_{i=1}^{n}[\ln\Gamma(\frac{1}{\alpha}+y_i)-\ln\Gamma(y_i+1)-\ln\Gamma(\frac{1}{\alpha})+y_i] \\ -(\frac{1}{\alpha}+y_i)\ln(1+\alpha\lambda_i)-\ln(1-(1+\alpha\lambda_i)^{-(1/\alpha)} \tag{2}$$

where α is the dispersion parameter and lambda (λ) is parametized as:

$$\ln\lambda=\beta_0+\beta_p TCOST+\beta_{inc}INC+\beta_{subs}SUBS+\beta_{tim}TIM+\beta_{pre}PRE+\beta_{osite}OSITE \\ +\beta_{ws}WS*TCOST+\beta_{flt}FLT*TCOST. \tag{3}$$

Inclusion of physical characteristics in pooled multisite models is not novel in count data demand models. For example, Englin and Shonkwiler (1995) include a number of physical site characteristics both binary (water present) and continuous (trail elevation) in their study of wilderness hiking demand. Creel and Loomis' (1990) study of deer hunting demand incorporates a number of site quality type variables based on hunter observations (e.g. number of deer seen, and number of passed kill opportunities). However, neither of these specifications allows for difference in price response based on these characteristics, that is, they are included as demand shifters. Thus, in the context of either the Poisson or negative binomial model structure wherein λ is typically parametized as a semilog function of socioeconomic and other variables, the price coefficient and hence consumer surplus would be invariant to physical characteristics.[4] Within such a structure, attempts at benefit transfer are limited to the same per trip surplus value regardless of the site characteristics.

The more flexible structure, designed to incorporate varying slope parameters and hence varying consumer surplus estimates, would be appealing for benefits transfer if there is reason to believe that consumer surplus afforded by a given activity is in fact affected by a vector of physical characteristics associated with the activity in a given setting. Vaughan and Russell (1982) showed this to be the case using a multisite linear zonal TC model of fishing demand.

In our study, the hypothesis can be tested in the context of the above specification by testing the null hypothesis, $\mathbf{H_0}$: $\beta_{ws} = \beta_{flt} = 0$, versus the alternative ($\mathbf{H_a}$: not $\mathbf{H_0}$). Given significance of a travel cost variable and interactions on Wild and Scenic designation and on float length, per trip consumer surplus may be calculated:

$$CS/Trip = \frac{-1}{[\beta_p + \beta_{ws} WS + \beta_{flt} FLT]} \qquad \textbf{(4)}$$

where, β_p is the estimated coefficient for the conventional travel cost variable, β_{ws} *WS* is the product of the coefficient on the travel cost interaction with Wild and Scenic designation the binary variable, and β_{flt} FLT is the product of the travel cost/float length interaction coefficient and the float length.

In order to address benefit function transfer feasibility, we estimate a series of five pooled models. In each case, data from one of the five rivers is systematically eliminated. This approach is somewhat like that followed by Loomis (1992) wherein multisite demand equations estimated for (*n*-1) rivers were used to predict demand for the n^{th} river. For each model estimated, the transfer function is then used to estimate consumer surplus for the omitted river. These surpluses are then compared with individually estimated river models and corresponding 95 percent confidence limits.

Finally, we compare results for the transfer functions wherein a given river is eliminated from the function which includes all rivers. This in-sample comparison based on the juxtaposition of individual models to a pooled model wherein all five rivers are included allows us to identify some potential problems resulting from extrapolation.

Results

Pooled truncated negative binomial parameter estimates using all river data are presented in Table 2 for the transfer functions corresponding to price interaction model in equation 3. Across the various time and travel cost assumptions, the null hypothesis that interactions are not present is rejected at the 0.01 significance level using a standard likelihood ratio test. Hence, it would appear that as in Vaughan and Russell's (1982) fishing study, price response and consumer surplus are likely affected by site characteristics. This result provides support for inclusion of price/characteristic interactions in future multisite modeling efforts.

The significance of the interaction terms also provides a convenient avenue for benefits transfer through the use of a function which incorporates esily idendifiable physical characteristics. To examine the transferability success of this transfer function approach we first estimated a series of pooled multisite interaction models wherein data for one of the rivers are systematically eliminated. Each model can then be used to predict consumer surplus for the out-of-sample river. Parameter estimates for these models are reported in Table 3 and Table 4. Table 3 is based on a 25 percent wage rate assumption and reported travel costs while Table 4 is based on a 25 percent wage rate and an imputed mileage cost.

In all but three of the models, both interaction terms are statistically significant. It most noteworthy that when either of the two Wild and Scenic Rivers (the Chattooga or Middle Fork) is removed from a given subsample, the interaction terms become insignificant (see Table 3 model NGKM or Table 4 models NGKM and NCGK). Not surprisingly in either of these scenarios the statistical significance of the characteristic/price interaction coefficients disappears because of the consequent lack of dispersion over sample space. Indeed excluding the Middle Fork in the reported cost model NCGK of Table 3 led to an insignificant price coefficient although the *FLT*TCOST* coefficient is significant.

For comparison, individual river models (without interactions) are estimated and reported in Table 5 through Table 9. Truncated negative binomial models are reported for the Chattooga and Nantahala Rivers while truncated Poisson models are reported for the remaining rivers as the null hypothesis of no overdispersion could not be rejected. Significant parameter estimates for each model are consistent with theoretical expectations. Performance and fit of these models along with consumer surpluses per trip ($CS= 1/-\beta_p$) appear reasonable and fall within the range of those reported in existing literature for this activity (see e.g., Boyle et al.1993 and Sanders et al.1991).

Consumer surplus estimates for the rivers are presented in Table 10 for both reported and imputed costs with 25% wage rate assumptions. Columns one through three represent point estimates of per-trip consumer surplus (PTCS) with 95% confidence limits. Column four lists the point estimate of per-trip consumer surplus for each out-of-sample river resulting from extrapolation of the benefits transfer functions estimated with the remaining rivers as reported in Table 3 and Table 4. In six of ten cases the predicted per trip consumer surplus from the out-of-sample transfer function falls outside the individual river's confidence interval for the same measure, thus rejecting an hypothesis of congruence.

At first glance, this result is disturbing in terms of the robustness of the respective benefits transfer functions. However, closer inspection reveals a pattern which is consistent with statistical "common sense" with regard to extrapolation beyond the range of one's data (Desvouges et al., 1992). For example, the NCGK models result in drastically low and significantly different predictions for per-trip consumer surplus on the Middle Fork. This result can best be explained when noting the Middle Fork observations comprise one extreme (with respect to trip length) in our river data. Removal of these observations has a dramatic effect on the regression coefficients and ultimately on estimated consumer surplus.

Qualitatively similar conclusions about the poor performance of the out-of-sample transfer models wherein the Chattooga River is omitted (NGKM's) can be drawn. In this case, congruence of the benefits transfer function estimate versus the individual estimate is rejected for both imputed and reported cost alternatives. Again, the explanation is related to what remains in the data for the Pooled-Out models. By removing the Chattooga, one of the two Wild and Scenic Rivers, only the Middle Fork is left as a Wild and Scenic River. The resulting attempt to estimate the benefits transfer function with only one cell with unique Wild and Scenic River - trip length values leads to unreliable and very inaccurate performance of the benefit transfer function.

In Table 10 column six we report consumer surplus estimates for each river based upon the transfer functions reported in Table 3 wherein all the data are included. Here only two out of ten cases indicate that the transfer function predicted surplus is incongruent with the surplus based upon the individual river model. With the imputed cost models, all of the benefit transfer function predicted consumer surpluses fall within the confidence bounds of the individual river model estimates. Comparing in-sample and out-of-sample results, it becomes obvious that rivers at the extremes of the data cause the most problem for benefits transfer functions and resulting surplus value transfer.

Discussion

We develop and test a number of in- and out-of-sample benefits transfer functions in the context of guided whitewater rafting recreation. In doing so we introduce and demonstrate the use of a modified count data demand model which allows for variation in consumer surplus estimates depending on river characteristics. We also provide an array of per-trip consumer surplus estimates for guided whitewater rafting over a wide range of rivers, modeling assumptions, and travel cost assumptions.

We think our findings suggest considerable potential for development of transferrable benefit estimators with this and other types of recreation demand modeling. Clearly, there are limits to the range of rivers and corresponding characteristics for which we feel these models appropriate. However, our results do suggest that the importance of incorporating site characteristics as slope interactions in multisite zonal travel cost models as demonstrated by Vaughan and Russell in 1982 is also relevant to individual count data models currently being used.

Our results address Loomis' (1992) position that value function transfer is superior to point estimate transfer in a couple of ways. First, we demonstrate that value function transfer is only as good as the dispersion of the data across key sites and characteristics. Not surprising, extrapolating with a parametric function or point estimate beyond the range of available data is likely to yield erroneous results. Sixty percent of our attempts as represented by the out-of-sample transfer models were resounding failures based on statistical tests of congruence. Differences from individually estimated models ranged from 14 to 302 percent. In all cases where there is a large discrepancy, the cause stems from trying to extrapolate beyond "reasonable" limits of the data. The in-sample models demonstrate a marked improvement with an eighty percent success rate; the two failures being marginal and at the extremes of the data. Here the differences between the individually estimated models and the transfer function surpluses are considerably closer, ranging from 0 to 57 percent overall.

Second, we think that the idea of pooling sites is necessary for useful transfer functions if the dispersion of characteristics necessary for parametric estimation is to occur. This echos Desvouges et al. (1990), however the necessity of having a situation where the study site and policy are "similar" becomes a matter of degree and may not be crucial if the characteristics of the policy site are included within the range of data in the multisite or pooled model.

Our results do not echo those of Downing (1992) and Downing and Ozuna (1996). They found lower rates of transfer success, 57 to 64 percent with CV transfer and 14 to 29 percent with individual TC models. Part of the lower success may be accounted for by the omission of site characteristics from their models. They also found that the benefits function transfer approach tended to overestimate benefits. Our findings indicate a pretty even split of over and under estimation which is promising.

As with most small-scale analyses, we acknowledge a number of limitations. First, our models are admittedly course in that we would have liked considerably more rivers to allow for increased complexity with respect to river characteristics. However, as Loomis et al. (1995) have shown, often characteristics tend to be highly correlated, and hence collinearity problems begin to emerge. Second, because our data are limited to one season, we make no attempt to address the important intertemporal transfer issue (see e.g., Cooper and Loomis, 1989 and Downing , 1992). Nevertheless, we think our results demonstrate that benefits transfer functions incorporating flexible consumer surplus estimates could have an important place in resource management. Ultimately, their success will depend on the development of comprehensive recreation and resource data bases from which detailed transfer functions can be developed. However efforts of this magnitude are obviously difficult for individual and small groups of researchers and will probably require a significant investment by the public sector. Nevertheless, we feel that this model and others like it offer potential to add objectivity and structure to benefits transfer problems.

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TABLE 1
Selected Characteristics of Study Rivers

	River				
	Chattooga	Gauley	Kennebec	Middle Fork	Nantahala
Trip length:					
Miles (ave.)	14	21	28	100	8
Float time	1-2 days	1-2 days	1-2 days	5-6 days	3-4 hours
Dam Controlled	No	Yes	Yes	No	Yes
Wild and Scenic Designation	Yes	No	No	Yes	No
Commercial Use Limits	Annual	None	None	Annual	Midweek days
Difficulty of Rapid	II-V	III-V	III-V	III-V	II-III
Normal Use Season	April-Nov	Sept-Oct	May-Sept	May-Sept	April-Nov
Market	Region	Nation	Region	Nation	Local-Region
Annual Commercial Use (1000's)	39	45	36	4.5	213

TABLE 2
Truncated Negative Binomial (TNB) Parameter Estimates
(Dep. var.= annual person trips / household) for In-Sample Interaction Models

	Reported Costs		Imputed Costs		
Variable	25% wage	50% wage	25% wage	50% wage	MEAN
CONSTANT	.1573	.1346	.4832	.3372	1
(|β/s.e.|)	(1.230)	(1.102)	(4.009)	(2.872)	
TCOST	-.0052	-.0041	-.0067	-.0047	
	(13.37)	(17.21)	(16.36)	(19.67)	
INC	.0118	.0129	.0109	.0122	67.12
	(8.999)	(9.924)	(8.810)	(9.726)	
SUB	.0222	.0221	-.0842	-.0523	.4403
	(.271)	(.276)	(1.048)	(.663)	
TIM	.0288	.3948	.1173	.0990	2.493
	(.758)	(1.051)	(3.129)	(2.623)	
PRE	.6677	.6821	.6313	.6996	.4895
	(8.150)	(8.423)	(8.520)	(8.646)	
OSITE	.2453	.2412	.2114	.2083	.4683
	(2.886)	(2.907)	(2.570)	(2.564)	
WS*TCOST	.0016	.0011	.0015	.0011	
	(3.523)	(3.753)	(3.542)	(3.731)	
FLT*TCOST	.00002	.00002	.00003	.00002	
	(3.954)	(4.239)	(5.616)	(4.768)	
α	.6993	.6122	.5312	.5124	
	(5.975)	(5.956)	(6.182)	(6.048)	
N	1038	1038	1038	1038	
LRS (H_0:all β=0)	1310.2	1335.6	1371.0	1372.5	
LRS (H_0:interaction β's=0)	74.64	68.28	106.0	77.74	

TABLE 3
Negative Binomial Parameter Estimates (Dep. var.= annual person trips / household) for Pooled River Models Using Reported Costs and 25% Wage Rate Assumption.

	Out-of-Sample River Models[5]				
Variable	NCGM	NCKM	NGKM	NCGK	CGKM
CONSTANT	.3655	.2362	.5965	.2653	-.1005
(|β/s.e.|)	(2.906)	(1.719)	(4.135)	(1.938)	(.629)
TCOST	-.0052	-.0052	-.0022	-.0013	-.0047
	(12.27)	(11.56)	(1.935)	(1.134)	(9.810)
INC	.0111	.0122	.0104	.0096	.0113
	(8.390)	(8.607)	(7.560)	(6.297)	(7.585)
SUB	.0997	-.0555	-.0083	-.0274	-.0101
	(1.262)	(.652)	(-.084)	(.292)	(.095)
TIM	.0443	.0348	-.0015	.0186	.0502
	(1.237)	(.855)	(.035)	(.315)	(1.188)
PRE	.5336	.6539	.6118	.7394	.7200
	(6.534)	(7.558)	(6.073)	(8.146)	(7.162)
OSITE	.2624	.3032	.6591e-1	.1844	.2281
	(3.266)	(3.431)	(.651)	(1.905)	(2.145)
WS*TCOST	.0011	.0013	.0125	.0002	.0020
	(2.553)	(2.822)	(3.737)	(.309)	(4.007)
FLT*TCOST	.00003	.00003	-.00001	-.00001	.00001
	(5.099)	(4.473)	(2.662)	(3.229)	(2.052)
α	.4801	.6450	.5606	.6856	.8347
	(5.665)	(5.675)	(5.378)	(5.574)	(4.643)
N	852	858	788	779	875
LRS (H_0: all β's=0)	817.7	841.5	825.4	705.3	716.8

TABLE 4
Negative Binomial Parameter Estimates (Dep. var.= annual person trips / household) for Pooled River Models Using Imputed Costs and 25% Wage Rate Assumption.

Variable	Out-of-Sample River Models[6]				
	NCGM	NCKM	NGKM	NCGK	CGKM
CONSTANT	.6532	.9328	.8654	.5280	.2355
(|β/s.e.|)	(5.455)	(7.244)	(5.832)	(3.947)	(1.592)
TCOST	-.0068	-.0070	-.0060	-.0052	-.0059
	(15.11)	(14.36)	(4.718)	(3.925)	(12.15)
INC	.0104	.0087	.0104	.0091	.0108
	(8.322)	(6.845)	(7.629)	(6.014)	(7.621)
SUB	-.0084	-.1463	-.1219	-.1041	-.0902
	(.111)	(1.774)	(1.225)	(1.133)	(.9245)
TIM	.1426	.0945	.7064	.1170	.1289
	(4.303)	(2.401)	(1.607)	(2.001)	(3.044)
PRE	.5696	.5905	.6187	.7672	.7303
	(7.076)	(6.834)	(6.090)	(8.438)	(7.454)
OSITE	.2278	.2570	.0419	.1986	.2162
	(2.947)	(3.029)	(.417)	(2.109)	(2.088)
WS*TCOST	.0014	.0014	.0047	.0010	.0017
	(3.080)	(3.301)	(1.326)	(1.590)	(3.573)
FLT*TCOST	.00003	.00004	-.000005	-.00003	.00002
	(6.685)	(6.378)	(.116)	(.603)	(3.380)
α	.3571	.4380	.4785	.5630	.6486
	(5.549)	(6.004)	(5.343)	(5.561)	(4.833)
N	852	858	788	779	875
LRS (H_0: all β's=0)	938.7	945.6	911.8	782.9	794.6

TABLE 5
Truncated Negative Binomial (TNB) Parameter Estimates
(Dep. var.= annual person trips / household) for the Chattooga River

Variable	Reported Costs 25% wage	Reported Costs 50% wage	Imputed Costs 25% wage	Imputed Costs 50% wage	MEAN
CONSTANT	.6624	.5365	.8761	.7356	1
(|β/s.e.|)	(3.453)	(2.839)	(4.839)	(4.096)	
TCOST	-.0052	-.0035	-.0055	-.0037	
	(7.117)	(7.910)	(8.133)	(8.709)	
INC	.0065	.0074	.0056	.0064	61.47
	(2.789)	(3.280)	(2.473)	(2.882)	
SUB	-.0736	-.0682	-.1362	-.1274	.5381
	(.5830)	(.5470)	(1.095)	(1.030)	
TIM	.4031	.3702	.3900	.3599	.4763
	(4.240)	(3.873)	(4.234)	(3.837)	
PRE	.6111	.6120	.5952	.5941	.4843
	(4.421)	(4.516)	(4.391)	(4.414)	
OSITE	.4369	.4455	.4842	.4819	.3498
	(3.290)	(3.415)	(3.695)	(3.712)	
α	.2884	.2785	.2625	.2649	
	(3.081)	(2.995)	(3.027)	(2.962)	
N	250	250	250	250	
LRS (H_0: all β's=0)	221.5	222.2	232.6	228.84	
E (CS/trip)	192.66	286.22	181.00	270.94	
90% Lower [7]	148.27	226.88	144.50	219.17	
90% Upper	237.03	345.57	217.50	320.85	
Mean TCOST	157.45	213.30	171.40	227.25	

TABLE 6
Truncated Negative Binomial (TNB) Parameter Estimates
(Dep. var.= annual person trips / household) for the Nantahala River

	Reported Costs		Imputed Costs		
Variable	25% wage	50% wage	25% wage	50% wage	MEAN
CONSTANT	.9294	.8503	1.067	.9334	1
(|β/s.e.|)	(3.248)	(3.094)	(3.735)	(3.395)	
TCOST	-.0073	-.0052	-.0080	-.0055	
	(4.934)	(5.403)	(5.760)	(5.862)	
INC	.0106	.0118	.0101	.0115	58.23
	(3.776)	(4.384)	(3.810)	(4.435)	
SUB	-.1324	-.1275	-.1343	-.1292	.6181
	(.8590)	(.8460)	(.9030)	(.8770)	
PRE	.5532	.5546	.5355	.5436	.4931
	(3.584)	(3.591)	(3.532)	(3.559)	
OSITE	.1125	.1177	.1206	.1229	.3959
	(.8200)	(.858)	(.9120)	(.9160)	
α	.3520	.3395	.3095	.3130	
	(3.749)	(3.774)	(3.662)	(3.712)	
N	163	163	163	163	
LRS (H_0: all β's=0)	205.7	209.1	212.8	213.8	
E (CS/trip)	136.91	191.29	124.70	182.50	
90% Lower	91.41	133.22	89.20	131.44	
90% Upper	182.42	249.36	160.21	233.56	
Mean TC	73.75	103.85	81.29	111.39	

TABLE 7
Truncated Poisson (TP) Parameter Estimates
(Dep. var.= annual person trips / household) for the Gauley River

	Reported Costs		Imputed Costs		
Variable	25% wage	50% wage	25% wage	50% wage	MEAN
CONSTANT	.0827	.1143	.2968	.2723	1
(|β/s.e.|)	(.370)	(.523)	(1.274)	(1.209)	
TCOST	-.0028	-.0030	-.0039	-.0036	
	(-3.196)	(-4.321)	(-4.361)	(-5.097)	
INC	.0042	.0075	.0052	.0084	48.492
	(1.91)	(3.199)	(2.410)	(3.636)	
SUB	.0751	.1490	.1087	.1803	.1333
	(.318)	(.627)	(.460)	(.758)	
TIM	.1740	.1970	.2312	.2263	1.2424
	(1.725)	(2.007)	(2.272)	(2.301)	
PRE	.6673	.6873	.6904	.7000	.5222
	(3.694)	(3.820)	(3.832)	(3.899)	
OSITE	-.1226	-.1638	-.1565	-.1996	.2500
	(-.626)	(-.836)	(-.799)	(-1.015)	
N	180	180	180	180	
LRS (H_0: all β's=0)	115.18	125.66	125.22	134.56	
E (CS/trip)	352.16	329.57	255.71	280.53	
90% Lower	171.44	204.48	159.54	190.26	
90% Upper	532.89	454.65	351.88	370.80	
Mean TCOST	253.02	326.40	282.02	355.41	

TABLE 8
Truncated Poisson (TP) Parameter Estimates
(Dep. var.= annual person trips / household) for the Kennebec River

	Reported Costs		Imputed Costs		
Variable	25% wage	50% wage	25% wage	50% wage	MEAN
CONSTANT	.4336	.3398	.5301	.4006	1
(|β/s.e.|)	(2.170)	(1.736)	(2.619)	(2.025)	
TCOST	-.0038	-.0027	-.0042	-.0029	
	(-5.232)	(-5.231)	(-6.169)	(-5.837)	
INC	.0094	.0105	.0097	.0108	52.97
	(4.616)	(5.055)	(4.798)	(5.215)	
SUB	-.4619	-.4610	-.4722	-.4664	.4516
	(-3.364)	(-3.376)	(-3.450)	(-3.421)	
TIM	-.3771	-.3881	-.3599	-.3764	.5983
	(-3.137)	(-3.221)	(-2.968)	(-3.103)	
PRE	1.1098	1.1164	1.1206	1.1223	.3871
	(7.667)	(7.738)	(7.721)	(7.766)	
OSITE	.0946	.0599	.1352	.0867	.2796
	(.494)	(.316)	(.705)	(.456)	
N	186	186	186	186	186
LRS (H_0: all β's=0)	193.0	195.2	188.5	204.5	202.9
E (CS/trip)	263.02	368.77	226.49	238.71	346.60
90% Lower	180.57	253.15	146.83	175.25	249.21
90% Upper	345.47	484.39	306.15	302.17	443.99
Mean TC	190.60	249.54	151.65	211.45	270.40

TABLE 9
Truncated Poisson (TP) Parameter Estimates
(Dep. var.= annual person trips / household) for the Middle Fork of the Salmon River

	Reported Costs		Imputed Costs		
Variable	25% wage	50% wage	25% wage	50% wage	MEAN
CONSTANT	-.2643	-.2417	.1908	.0534	1
(|β/s.e.|)	(-.536)	(-.496)	(.368)	(.106)	
TCOST	-.0017	-.0016	-.0019	-.0017	
	(-6.641)	(-7.166)	(-7.272)	(-7.539)	
INC	.0173	.0179	.0169	.0174	99.151
	(7.505)	(7.793)	(7.380)	(7.624)	
SUB	.0295	.0692	-.0110	.0413	.4595
	(.211)	(.497)	(-.079)	(.297)	
TIM	.1197	.1204	.1219	.1215	5.6655
	(2.882)	(2.890)	(2.939)	(2.915)	
PRE	.1157	.0865	.1265	.0953	.2008
	(.725)	(.546)	(.794)	(.603)	
OSITE	.2116	.2153	.1534	.1721	.3475
	(1.494)	(1.536)	(1.083)	(1.230)	
N	259	259	259	259	
LRS (H_0: all β's=0)	248.0	263.7	260.8	273.0	
E (CS/trip)	604.03	625.12	527.69	584.03	
90% Lower	454.87	482.05	408.68	456.98	
90% Upper	753.19	768.19	646.69	711.08	
TCOST	1456.10	1616.80	1501.30	1662.10	

TABLE 10
Individual, Pooled Out-of-Sample, and Pooled In-Sample
Consumer Surplus Estimates and Benefit Transfer Congruence Tests.

Reported Costs and 25% Wage Rate Assumption

River	Individual CS/Trip	95% Lower	95% Upper	Out Sample CS/Trip	Change vs Individual	In Sample CS/Trip	Change vs Individual
Chattooga	$192.66	139.93	245.39	-114.70*	-159.9%	303.09*	57.3%
Gauley	$352.16	137.49	566.83	212.40	-39.7%	212.23	-39.7%
Kennebec	$263.02	165.08	360.96	225.49	-14.3%	219.77	-16.4%
Middle Fork	$604.03	426.85	781.21	63.66*	89.4%	761.54	26.1%
Nantahala	$136.91	82.86	190.96	219.81*	60.5%	199.52*	45.7%

Imputed Costs and 25% Wage Rate Assumption

River	Individual CS/Trip	95% Lower	95% Upper	Out Sample CS/Trip	Change vs Individual	In Sample CS/Trip	Change vs Individual
Chattooga	$181.00	137.64	224.36	728.18*	302.3%	213.28	17.8%
Gauley	$255.71	141.47	369.95	161.41	-36.8%	167.39	-34.5%
Kennebec	$238.71	163.33	314.09	170.24	-28.7%	174.03	-27.1%
Middle Fork	$527.69	386.32	669.06	141.45*	-73.2%	529.30	0.31%
Nantahala	$124.70	82.53	166.87	173.82*	39.4%	156.32	25.4%

* Indicates signficance at α=.05 level.

Endnotes:

1. The temporal dimension is also addressed in a body of contingent valuation literature. There it is referred to as temporal stability or reliability.

2. Due to the often encountered collinearity problem between time and monetary travel costs, estimation attempts for models disaggregating these variables proved unsuccessful.

3. We use time costs ranging from zero to 50% of the household wage rate in conjunction with both imputed mileage costs at $0.092 per mile (Mateja, 1995) and actual reported transportation variable costs. In all cases, reported outfitter fees are included.

4. It should be noted that Englin and Shonkwiler (1995) incorporate an interaction between travel cost and gender which is significant in one of their models. This implies a price response difference and thus a consumer surplus difference between males and females in the sample. They do not use this model in their subsequent discussion and aggregation, opting instead for a restricted model which omits this interaction.

5. Pooled models are delineated by the first initial of each river. Hence, NCGM represents a model based on pooling the Nantahala, Chattooga, Gauley, and Middle Fork of the Salmon.

6. Pooled models are delineated by the first initial of each river. Hence, NCGM represents a model based on pooling the Nantahala, Chattooga, Gauley, and Middle Fork of the Salmon.

7. Confidence intervals for the mean of per-trip consumer surplus are calculated via a Taylor series approximation (Kmenta 1986, p.486).