Issues in Nonmarket Valuation and Policy Application: A Retrospective Glance

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While issues in estimating nonmarket values continue to cause concern, resource economists have more reason now than ever before to be optimistic. More progress toward improved measurement has been made in the past six years than in the previous quarter century since development of the contingent valuation and travel cost methods. The new challenge is to learn how to adjust past studies to estimate nonmarket values for future policy analysis. The process involves developing an understanding of the important variables that explain the observed difference in estimates. This paper illustrates how the results thus far could be adjusted to develop some tentative estimates of the recreation-use value of Forest Service resources.

Key words: contingent valuation method, information transfer, outdoor recreation, travel cost method.

In the past, most studies of the nonmarket value of natural resource use for outdoor recreation focused on questions of management at a specific location. Although there is a growing body of findings from such studies, the increased demand for research results has far outpaced supply constrained by reduced budgets of funding agencies (President's Commission on Americans Outdoors). As a result, some observers have begun to question whether past studies can be applied to future resource policy decisions. Could the present stock of studies have a dual purpose with a direct use in policy application at the study site and an indirect use to answer policy questions at other times and places?

If the existing studies produce the same set of findings, then an agency could with confidence predict the benefit of recreation activities at new or expanded sites. However, if the studies produce widely varying results for unexplained reasons, an agency could not easily predict the value of recreation based on the available literature. Adjustments would have to be made to facilitate the transfer of findings from the locations where studies were performed to areas where they were not. Even where studies were conducted, improved data transfer procedures could increase the precision of future net benefit estimates.

For this purpose, there is a need for research to develop an understanding of the variables that explain the observed difference in estimates. This paper follows standard procedures developed by metaanalysis, the growing science of reviewing research (Cooper; Light and Pillemer). The approach introduces precision into the analysis with respect to specific purpose of the literature review; the selection of the studies for review; the similarity of the units of analysis and subject matter across studies; the distribution of study values; and the relationship of study values to research design, characteristics of participants, quality of the sites, and management programs.

Updated and Adjusted Benefits

The source of data for this paper is the literature on demand for outdoor recreation with

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nonmarket benefit estimates from 1968–88. The study represents an update and evaluation of a previous review by Sorg and Loomis. Their 93 benefit estimates in studies completed from 1968–82 are supplemented with 20 they missed plus 164 estimates in studies completed from 1983–88. The objective is to provide a range of benefit estimates for major recreation activities in Forest Regions for the 1990 resource planning program (RPA) of the Forest Service, U.S. Department of Agriculture. Congress requires that the agency prepare long-run (50-year) forest plans every five years. As part of this process, the agency periodically reviews demand studies applying the contingent valuation (CVM), travel cost (TCM), and related methods to provide an empirical basis for revision of unit-day values. For example, the Dwyer, Kelly, and Bowes literature review contributed, in part, to estimation of recreation values for the 1980 RPA. The exercise has been controversial because the agency, lacking a scientific basis for adjustment, has relied on the concept of reasonable and proper levels for the purpose intended.

Detailed descriptions and evaluations of the design aspects of studies completed from 1968–82 were prepared by Sorg and Loomis on behalf of the Forest Service 1985 RPA. As might be expected, many of the early studies were of dubious quality from the standpoint of being able to make benefit inferences. Only midway in the review period did the federal government (Water Resources Council 1973, 1979) issue guidelines on statistical sampling, vehicle travel cost, travel time cost, substitutes, and other aspects of experimental design to be used by new studies. The guidelines clearly were minimal when judged by the standards of some of the best studies. Even so, several of the studies did not meet them in important respects and, therefore, were of almost no value in establishing comparable measures of the net benefits of recreation activities. The consensus judgment of a panel of evaluators was that substantial adjustment should be made in the reported values before presentation of the summary statistics.

As a result, Sorg and Loomis increased the reported TCM values by 30% for the omission of travel time, both TCM and CVM values were increased by 15% for omission of out-of-state users, and TCM values were decreased 15% for application of the individual observation approach. They argued that omission of travel time from the TCM demand function leads to a downward bias in estimated benefits. The cost of time spent traveling equals the difference between the net willingness to pay for sightseeing benefits enroute and the opportunity cost of the time in an alternative activity. Similarly, omission of out-of-state users tends to understate the number of visits to most resource-based sites at relatively higher travel costs. If they travel further than in-state users, the upper limit of travel cost in the demand curve will be understated and benefits will be biased downward. The individual observation approach uses trips per participant as the dependent variable. While this is statistically more efficient than the zonal approach, it omits the effect of travel cost on the probability of participating. The resulting demand curve is often less elastic which results in overstating recreation benefits of activities when the probability of participation decreases significantly at higher travel costs.

Table 1 illustrates the resulting summary statistics for the recreation use categories of the Forest Service. The 287 estimates of net economic value per day reported by 120 outdoor recreation demand studies from 1968 to 1988 are adjusted for method as in Sorg and Loomis and are in third-quarter 1987 dollars. Mean value of the estimates is \$34 per day with a 95% confidence interval of \$31 to \$37 and a range of \$4 to \$220. The median is \$27. These values are shown for each activity along with output of the agency. Average benefit of activities ranges from \$12 to \$72 per day with the highest values reported for hunting, fishing, nonmotorized boating, hiking, and winter sports. This approach assumes that the socioeconomic characteristics of users and the quality of study sites are sufficiently similar that a common pattern of consumption applies to each. Ideally, the distribution of values would be approximately normal with a few outliers at both the high and low ends. Given a sufficient number of studies, the solid core of values in the middle would be the most reasonable estimate.

A number of problems should be considered before analysts could reasonably apply this information to policy decisions. First, for most recreation activities, an insufficient number of studies have been completed to obtain reasonable estimates of value by this method. Even where there are a large number of studies, the frequency distribution is often skewed with the

Table 1. Net Economic Values Per Day Reported by TCM and CVM Demand Studies from 1968 to 1988 Applied to National Forest Recreation Use Categories, United States (Third Quarter, 1987 Dollars)

Activity	Visitor days 1,000[a]	Number of Estimates	Mean	Median	Standard Error of the Mean	95% Confidence Interval	Range
Total	226,533 (100.0%)	287 (100.0%)	$33.95	$27.02	1.67	30.68– 37.22	3.91–219.65
Camping, Picnicking, and Swimming	66,811 (29.5)	36 (12.5)	20.14	17.80	1.80	16.61– 23.67	7.05– 46.69
Camping	53,666 (23.7)	18 (6.3)	19.50	18.92	2.03	15.52– 23.48	8.26– 34.89
Picnicking	7,838 (3.5)	7 (2.4)	17.33	12.82	5.08	7.37– 27.29	7.05– 46.69
Swimming	5,405 (2.3)	11 (3.8)	22.97	18.60	3.79	15.54– 30.40	7.05– 42.94
Mechanical Travel and Viewing	68,423 (30.2)	11 (3.8)	25.42	21.44	5.14	15.35– 35.49	8.27– 68.65
Sightseeing and Off-road Driving	62,451 (27.6)	6 (2.1)	20.29	19.72	3.73	12.98– 27.60	10.33– 31.84
Boating, Motorized	4,301 (1.5)	5 (1.7)	31.56	25.67	10.36	11.25– 51.87	8.27– 68.65
Hiking, Horseback Riding, and Water Travel	19,900 (8.8)	17 (5.9)	41.74	24.72	10.53	21.10– 62.38	10.26–183.36
Hiking	12,740 (5.6)	6 (2.1)	29.08	23.62	5.82	17.67– 40.49	15.71– 55.81
Boating, Nonmotorized	3,419 (1.5)	11 (3.8)	48.68	25.36	15.85	17.61– 79.75	10.26–183.36
Winter Sports	14,730 (6.5)	12 (4.2)	28.50	24.39	4.48	19.72– 37.28	11.27– 66.69
Resorts, Cabins, and Organized Camps[b]	15,117 (6.7)	2 (0.7)	12.48	—	—	—	3.91– 19.93
Hunting	15,276 (6.7)	83 (28.9)	41.69	34.88	2.72	36.36– 47.02	16.58–142.40
Big Game Hunting	10,729 (4.7)	56 (19.5)	45.47	37.87	3.47	38.67– 52.27	19.81–142.40
Small Game Hunting	4,015 (1.8)	10 (3.5)	30.82	27.48	3.51	23.94– 37.70	18.72– 52.04
Migratory Waterfowl Hunting	532 (0.2)	17 (5.9)	35.64	25.27	5.87	24.13– 47.15	16.58–102.88
Fishing	15,208 (6.7)	88 (30.7)	39.25	29.59	3.80	31.80– 46.70	8.13–219.65
Cold Water Fishing	10,687 (4.7)	39 (13.6)	30.62	28.49	3.24	24.27– 36.97	10.07–118.12
Anadromous Fishing[c]	— —	9 (3.1)	54.01	46.24	11.01	32.43– 75.59	16.85–127.26
Warm Water Fishing	4,072 (1.8)	23 (8.0)	23.55	22.50	2.46	18.73– 28.37	8.13– 59.42
Salt Water Fishing	226 (0.1)	17 (5.9)	72.49	53.35	14.05	44.95–100.03	18.69–219.65
Nonconsumptive Fish and Wildlife	1,532 (0.7)	14 (4.9)	22.20	20.49	2.30	17.69– 26.71	5.27– 38.06
Other Recreation Activities	9,537 (4.2)	9 (3.1)	18.82	16.06	3.65	11.67– 25.97	6.81– 43.39
Wilderness	12,014[d] (4.5)	15 (5.2)	24.58	19.26	6.10	12.62– 36.54	8.72–106.26

[a] Thousands of 12-hour recreation visitor days reported by the Forest Service, U.S. Department of Agriculture, for the year ending September 30, 1986. *Statistical Abstract of the United States, 1988*, p. 212.

[b] Resorts were 1.83% valued at $19.93 per day; seasonal and year-around cabins were 3.06% valued at $3.91 per day; and organized camps were 1.79% valued the same as camping.

[c] Anadromous fishing estimates included in cold water fishing. Estimated as roughly 5%.

[d] Included above.

majority of estimates clustered near the bottom of the range in values and a relatively few extremely high estimates. This substantially increases the sample mean, and thus it is questionable whether the mean truly reflects the sample as a whole. The median would be a more appropriate measure to use if the purpose of the analysis is to determine a representative estimate.

Second, the approach does not reveal what is causing the extreme range in values, whether variation in characteristics of users, quality of sites, or research methods. A potentially useful approach to the data transfer problem would be to pool the data from existing studies and apply multiple regression analysis. If the basic model specification is complete, that is, if it includes all the relevant explanatory variables in the correct functional form, then it could explain the variation in benefits embodied in differences among the explanatory variables. The net benefit estimated for a site lacking data would then be predicted by inserting appropriate values of explanatory variables into the model fitted to data from the other study sites.

Theoretical Basis for an Empirical Model

The empirical model used to explain the variation in benefit estimates should be based primarily on applied microeconomic theory (McKean and Walsh; U.S. Department of the Interior). In an ordinary demand function for a recreation site, the dependent variable to be explained is the quantity demanded. The list of independent variables that influence demand includes a proxy for direct cost or price and such factors as travel distance or the value of time, the price and availability of substitutes, consumer income, other socioeconomic variables such as age, quality or attractiveness of the site, population of the consuming group, individual taste or preference, and expectations or experience with respect to crowding. Other variables related to research method may include: recreation activity; sample size and coverage; CVM, TCM, or other method; statistical model; econometric estimators; type of CVM question; and site administration.

The possible effect of the specification of each of these variables should be carefully evaluated. For example, measurement of quantity demanded in different units may affect the benefit estimate, whether trips, hours, visitor days per person or per capita. Choice of travel cost measurement as distance multiplied by variable travel cost per mile from the U.S. Department of Transportation or reported by respondents may also affect benefit estimates (Duffield). The effect of travel time cost on benefit estimates has been shown to vary with the percent of wage rate used (McCollum, Bishop, and Welsh). Shaw considers the effect of sample truncation and related problems of on-site surveys. Smith and Kaoru make an important contribution to understanding the effects of alternative methods of estimating travel time cost, presence of a substitute price term, use of a regional model, type of site studied, functional form (linear, log-linear, or semilog), and estimators (ordinary least squares, generalized least squares, or maximum likelihood-logit-tobit) used in TCM studies. They conclude that these methodological variations significantly affect benefit estimates. The question remains whether method would have the same effect in a regression model holding constant the effects of other potentially important variables.

In the future, it seems likely that an ever larger number of studies will be accumulated on the demand for outdoor recreation. In this event, each subsequent work in the growing science of reviewing research can examine many possible variables that might be important and provide a basis for eliminating some of them as serious candidates for new research. Using prior reviews to reduce the number of experimental variables should improve the statistical analysis and allocation of resources to new studies. Thus, each succeeding literature review should build upon previous ones.

In the early stages of this evolving process, the critical problem will be to correctly specify the variables that are expected to influence the benefit estimates. For if important determinants are omitted, the statistical equation will not predict effects accurately, as illustrated by Allen, Stevens, and Barrett. Thus, the early review efforts should be treated with caution, since by leaving important variables out of the regression analysis, more or less of the variation may be attributed to those that are included than would be the case with a more complete specification, as illustrated by Smith and Kaoru.

Research Procedure

A systematic search of the available literature was conducted in an effort to review as many empirical studies as possible from 1968 to 1988. The selection process was designed to fairly represent all the research on the topic in the United States. Included were studies in journals, chapters in books, unpublished research reports, masters and doctoral theses, research reports from private organizations and government agencies, and conference papers. In a number of cases, the authors were contacted by telephone to clarify a methodological question or to obtain the results of unpublished studies. The overall effect of the selection process was to provide sufficient studies to identify interesting trends and get a broad flavor of the findings from both published and unpublished studies.

The values reported here represent consumer surplus calculated by the authors of each study from the demand functions they reported. The net economic values are equivalent to the dollar amount participants would be willing to pay over and above their current expenditures to ensure continued availability of the opportunity to use recreation resources. The review is limited to studies measuring the on-site recreation-use benefits provided by a natural resource of given quality. Many of the studies also estimate the change in benefits with changes in the quality of the resource, and interested readers are referred to the detailed descriptions of the original studies for estimates (Walsh, Johnson, and McKean). Also, the values reported here do not include the public benefits from preservation of resource quality such as option values of future use and existence values to the general population of users and nonusers (Walsh).

The standard unit of measurement is an activity day, defined as one person on site for any part of a calendar day. When values are reported on any other basis than per activity day, they are adjusted to this common unit. For TCM demand functions, the appropriate unit of analysis often is number of trips, but most authors also report the results in terms of value per activity day. If not, values per trip are divided by the reported number of days per trip. Similarly, annual values are divided by the reported days of participation. Household group values are divided by the number of persons and days of participation per person. Where the value of recreation activities is reported for hypothetical quality changes, the base value for current site quality is used. There is a problem of defining recreation activity days at some sites, notably reservoirs with camping, swimming, boating, and fishing on the same trip. In this case, the concept of recreation use is based on the standard procedure of the U.S. Census in which an activity is defined as primary use when it represents over 50% of total individual activity while at the site.

Table 2 defines the explanatory variables included in the equations. Most are conventional measures and require little added explanation. Nearly all of the variables are qualitative, indicating that a particular treatment is either present or absent. Of primary interest are the three adjustments by Sorg and Loomis for omission of travel time, the use of individual observations, and in-state sample coverage discussed earlier in this paper. Other important determinants of demand are included to hold constant their effects and to estimate the partial effect of each of these variables and other possible candidates for adjustment in benefit estimates. The other variables are: recreation activity; whether specialized or general; site administration; quality; location; inflationary adjustment; method; open-ended, iterative, or dichotomous choice question; zonal, household production or hedonic price approach. The variable list is constrained by the availability of information, time, and budget for this study. As a result, some potentially important variables are omitted: direct travel cost per mile, travel time cost per hour, income and other specific socioeconomic variables, sample size, functional form, and type of estimator used.

A quality variable is included to control for specific characteristics of sites which vary among recreation activities and expectations of individual participants. Sufficient information is available in the studies to apply a rough index of site quality in three categories—uniquely low, ordinary, and uniquely high—based on a review of the physical and biological information provided. A site administration variable is included to test the hypothesis that Forest Service administered site benefits are not significantly different from other public and private sites. A mixed public-private site variable tests the hypothesis that household surveys are more effective than on-site studies,

Table 2. Description of Variables in the Analysis

Name	Definition of Variable
Dependent Variable	Consumer surplus estimated by each study, standardized to average values per activity day, adjusted to third quarter 1987 dollars.
Site Quality	Qualitative Variable = 1 if site was rated by each study as uniquely high quality; 0 if medium or low.
Forest Service Administered	Qualitative Variable = 1 if the study sites were Forest Service administered; 0 if otherwise.
Mixed Public & Private Sites	Qualitative Variable = 1 if household survey of participants in an activity at public and private sites; 0 if otherwise (the omitted categories were other wholly public and wholly private).
Specialized Activity	Continuous variable = percent. Proportion of total recreation use of U.S. Forest Service resources in the activity category. Proxy of taste and preference for specialized vs. generalized activities.
Inflationary Adjustment	Qualitative Variable = 1 if data were collected for each study prior to 1980; 0 if 1980–1988.
Sample Coverage	Qualitative Variable = 1 if only in-state residents were included in the sample of users; 0 if out-of-state residents were also included.
Method	Qualitative Variable = 1 if CVM; 0 if TCM or other method.
Substitution	Qualitative Variable = 1 if a substitute price term was included in the TCM demand specification; 0 if otherwise.
Travel Time	Qualitative Variable = 1 if travel time cost was omitted in the TCM demand specification; 0 if time was included.
Individual Observation	Qualitative Variable = 1 if TCM sample units were individual observations; 0 if otherwise.
Household Production & Hedonic Price	Qualitative Variable = 1 if household production or hedonic price TCM procedure; 0 if otherwise (the omitted category was the zonal group approach).
Open-ended Question	Qualitative Variable = 1 if noniterative open-ended question was asked in a CVM; 0 if otherwise.
Dichotomous Choice Question	Qualitative Variable = 1 if dichotomous choice CVM question was used; 0 if otherwise (the omitted category was the iterative question).
Socioeconomic Characteristics	Proxy for socioeconomic characteristics of participants in the service area of the study site. The nine Forest Regions are qualitative variables. Alaska is the omitted region.
Recreation Activity	The 19 national recreation use categories are potential qualitative variables for activities. Omitted categories include activities with limited representation in the studies, i.e., resorts, cabins, and organized camps.

whether public or private. A specialized activity variable tests the hypothesis that benefits are lower for general activities than for specialized activities. This may be interpreted as a proxy for taste and preference. The federal guidelines (Water Resources Council 1983) differentiate between general recreation activities engaged in by a large number of persons and specialized recreation limited to fewer participants with unique preference patterns. The guidelines associate specialized recreation with higher unit-day values than general recreation.

An inflationary adjustment variable is intended to begin examining the question of whether recreation values increase at the same rate as changes in the purchasing power of the dollar. For comparison purposes, the reported values must be adjusted for inflation. However, this is equivalent to assuming constant real prices which would not be consistent with increased crowding and relative scarcity of natural resources available for resource-based recreation activities (President's Commission on Americans Outdoors). Moreover, the procedure assumes an equal proportional change in the reported values for any given year which tends to dampen (enlarge) the absolute dollar adjustment for studies reporting low (high) values. This is evident for surveys from 1968–79 when the inflation rate was 6.9% compared to 4.8% from 1980–87. Finally, willingness to pay is, in part, a function of ability to pay which suggests that secular adjustments for per capita real income would be useful.

A method variable is included to test the hypothesis that intended willingness-to-pay estimates of the CVM are lower than behavior-based TCM. This would be consistent with the observation that TCM values the entire trip including the primary activity and secondary activities while the CVM usually values the primary activity alone. For example, TCM always values the entire time on site per calendar day of a trip while CVM usually values only that part of the day that pertains to the primary activity, e.g., the four hours devoted to fishing each day.

Willingness to pay for a constant unit of recreation use of an existing site should be approximately the same since both methods yield similar though not identical demand curves. The TCM estimates an ordinary Marshallian demand curve while the CVM estimates a Hicksian compensated demand curve. Both approaches specify that benefit is a function of the number of trips to a recreation site which is separable in consumption and subject to a budget constraint. If the specification of quantity and other variables can be controlled, theory suggests that there should be little or no difference between values obtained by the two methods.

A variable indicating location of the study sites in Forest Regions is included as a proxy for socioeconomic characteristics of the user population. Since the regression model controls for site quality and substitutes, the other important effect of location is the distribution of income and other socioeconomic characteristics of the population in the relevant market for the study site. While extensive data on household demographics and equipment ownership are available for outdoor recreation activities from national and state samples, similar information is available only for a small fraction of the studies reviewed here. Thus, this important feature of variation in benefits would have to be ignored without an effective proxy variable.

Statistical Results

With the increased output of empirical studies in recent years, there is enough data to begin understanding the variables which explain the observed differences in benefit estimates. Table 3 includes three functions showing the statistical relationship of recreation benefits to some important explanatory variables. These are for the total sample of 287 benefit estimates, 156 TCM and related estimates, 129 CVM estimates (and two hedonic price estimates). The number of observations is sufficient for statistically significant analysis. The R^2, adjusted for degrees of freedom, indicates that 36% to 44% of the total variation in the reported values is explained by the variables included in the functions. The overall equations are significant at the .01 level. The t-statistics shown in parentheses beneath the coefficients indicate that about two-thirds of the variables (27 of 42) are significant at the .10 level or above. Omission of the coefficient for a variable (—) indicates that it is not statistically related to benefits.

The panel nature of the data render the usual statistical tests of the model an approximation rather than a precise estimate. Although the residuals are close to normally distributed, heteroskedasticity is likely to be present in any study with parameters drawn from different data sets. Even though review of the correlation matrixes indicates mostly low levels, multicollinearity is likely to result from inclusion of more than one benefit estimate from some studies. The t-statistics somewhat over- or underestimate variable significance based on a Smith and Kaoru comparison of OLS estimates with the Newey and West variation of the White consistent covariance estimates of standard errors used in calculating t-statistics.

Of primary interest here are the variables estimating the effect of the three adjustments in benefit by Sorg and Loomis, namely, for omission of travel time cost, use of the individual observation approach, and for in-state samples at sites with out-of-state users. The increase in reported values by 30% for omission of travel time cost seems to be about right. The statistically significant coefficient indicates that TCM benefits are about 34% less for the 30 studies omitting travel time cost, other variables in the equation held constant. (The 13.333 coefficient for travel time cost is 34% of TCM mean value of $39.) On the other hand, the decrease in reported benefits by 15% for use of the individual observation approach seems quite conservative. The significant coefficient indicates that benefits are 46% greater for the 52 TCM studies using individual observations. The increase of both TCM and CVM values by 15% for omission of out-of-state users appears to be about right for the total sample where the coefficient shows a 20% increase, although not statistically significant. The 15% adjustment seems conservative for TCM studies where the significant coefficient indicates the correct adjustment would be an increase of about 30%. Thus, while the three adjustments appear about right or to err on the low side, their overall effect is reasonably correct. The regression for the total sample (table 3) indicates that when variations in site qual-

Table 3. OLS Regressions of Recreational Values on Several Important Explanatory Variables, United States, 1987

Independent Variable	Description of Variable	Total		Travel Cost Method		Contingent Valuation Method	
		Mean	Coefficient[a]	Mean	Coefficient[a]	Mean	Coefficient[a]
Site quality	1 = High 0 = Other	0.129	33.568* (7.51)	0.154	39.171* (6.06)	0.101	25.082* (4.42)
Specialized activity	Percent of Forest Service output	4.917	−0.574* (−2.23)	5.235	−0.679* (−1.83)	4.571	−0.147 (−0.519)
Forest Service administered	1 = Forest Service 0 = Other	0.230	4.931 (0.98)	0.218	6.204 (0.84)	0.248	2.594 (0.42)
Mixed public and private sites	1 = Mixed 0 = Other	0.596	9.891* (2.29)	0.571	6.933* (1.12)	0.636	13.539* (2.46)
Inflationary adjustment	1 = 1980–88 0 = 1965–79	0.564	−7.971 (−2.35)	0.436	−10.579* (−2.03)	0.721	−16.582* (−3.31)
Sample coverage	1 = In-state sample 0 = Other	0.115	−6.892 (−1.33)	0.186	−11.759* (−1.77)	0.031	−7.464 (−0.86)
Method	1 = CVM 0 = TCM	0.449	−8.098* (−2.34)		—		—
Sorg-Loomis adjustments	1 = Not adjusted 0 = Adjusted	0.578	−4.290 (−1.09)		—		—
Travel time cost	1 = Omitted 0 = Included		—	0.192	−13.333* (−1.90)		—
Substitution variable	1 = Included 0 = Omitted		—	0.647	−10.831* (−2.05)		—
Individual observation	1 = Indiv. obs. 0 = Other		—	0.333	17.950* (3.44)		—
Household production & hedonic price	1 = HP 0 = Other		—	0.083	9.499 (1.03)		—
Open-ended question	1 = Open-ended 0 = Other		—		—	0.333	−3.659* (−0.76)
Dichotomous choice question	1 = Dichotomous 0 = Other		—		—	0.101	3.503 (0.62)
Southern region	1 = Southern 0 = Other	0.094	−13.089* (−2.48)	0.122	−12.333* (−1.66)	0.062	−10.998* (−1.67)
Northwest region	1 = Northwest 0 = Other	0.052	−10.676 (−1.47)		—	0.039	−12.186* (−1.53)
Pacific SW Region	1 = Pacific SW 0 = Other	0.059	−10.683* (−1.66)		—		—
Intermountain region	1 = Intermountain 0 = Other	0.171	−9.252* (−2.18)		—	0.155	−13.517* (−2.98)
Salt water and anadromous fishing	1 = S-A Fishing 0 = Other	0.091	34.566* (6.20)	0.096	42.939* (5.10)	0.085	24.454* (4.02)
Big game hunting	1 = Big Game 0 = Other	0.199	21.817* (5.33)	0.186	23.037* (3.58)	0.209	16.664* (4.04)
Waterfowl hunting	1 = Waterfowl 0 = Other	0.063	11.325* (1.80)		—	0.093	7.042* (1.28)
Constant			33.579* (6.89)		33.769* (4.24)		28.543* (3.98)
Sample size			287		156		129
Adjusted R^2			.36		.39		.44

[a] T-ratios are shown in parentheses; a single asterisk indicates that the coefficient is significant at the 0.10 level or greater.

ity, recreation activity, region, method, etc. are held constant, no significant difference remains between the mean value of adjusted and unadjusted studies.

Another critical issue, of course, in the evaluation of the Sorg and Loomis adjustments is whether they are supported by applied microeconomic theory, accepted econometric procedures, and the federal guidelines. Obviously, some adjustment for the omission of travel time is required; however the precise level is not known and would vary for each study site. The statistical effect of the travel time cost variable could be improved if specified as a continuous variable in dollars per hour rather than as a qualitative variable indicating presence or absence of the adjustment. With respect to the adjustment for use of individual observations in TCM studies, some economists argue that values from zonal studies should be increased rather than decreasing values from individual observation studies because of the dampening effect of the aggregation problem in the zonal approach (McConnell and Bockstael). Finally, limitation of the sample to in-state residents originates in the institutional constraints of the researcher. The precise level of adjustment for sample truncation would vary with the actual origin of the user population of each site.

The regression results indicate other prime candidates for adjustment not considered by the earlier work. Benefit estimates from TCM studies omitting an effective cross-price term for substitution could be decreased about 30% according to the regression results. If the behavior-based TCM becomes the accepted standard for benefit estimation, then the CVM estimates of intended willingness to pay would be increased by an average of 20–25%. The results suggest that benefit estimates from CVM studies using dichotomous choice questions may be closer to TCM benefit estimates, perhaps requiring about half as much adjustment. However, benefit estimates from CVM studies asking open-ended willingness-to-pay questions could be increased by 10–15% based on the preliminary regression results considered here. These are but a few of the possible adjustments that should be considered in applying the Sorg and Loomis approach of making adjustments before presenting statistical summaries of the data in policy applications.

An important question raised by the Forest Service in applying the data to policy decisions is whether the benefit estimates from other public and private recreation sites are applicable to Forest Service resources. The insignificant coefficient for study sites administered by the agency suggest that there may be no appreciable difference. Apparently, the benefit estimates from the literature review apply to valuation of the agency's recreation program. In theory, benefit estimates for a forest lacking data can be predicted by inserting appropriate values of explanatory variables into the regressions. Unfortunately, an insufficient number of studies have been completed to obtain more than a few estimates of value by this method. The agency requires benefit estimates for 19 national recreation-use categories in nine Forest Regions for a total of 171. However, only three of the 19 national recreation-use categories and four of the nine Forest Regions are significant in the models fitted to data from the study sites (table 3). The other regions may not differ significantly from the average and thus cannot have significant coefficients, or possibly sample size for these regions is too small.

The specialized activity variable could provide a rough indication of the benefit for some activities with few studies. For example, the benefit of sightseeing and off-road driving, the largest single recreation activity with 27.6% of total output, would be \$20 per day [= 39 − (27.6 × .679)] based on the TCM equation. This compares favorably to the mean of \$20 for six studies of this activity (table 1). It seems likely that the agency will need to rely on a combination of several approaches until a greater number of studies of most recreation activities have been completed (McCollum et al.; Bergstrom and Cordell).

Finally, these results should be considered tentative and subject to revision with more complete specification of the model. Sensitivity analysis omitting various combinations of variables from the final equation significantly changes the coefficients of those remaining (as in Atkinson and Crocker; Smith and Kaoru). This suggests that leaving important variables out of the final equations may attribute too much of the variation in benefit estimation to the differences in method that are included. Nonetheless, the equations in table 3 include many possibly important variables and provide a basis for eliminating some of them as serious candidates for new research. The task remains to discover how far these results can be generalized. The importance of continued research is illustrated by the conceptual and empirical difficulties associated with estimation and the potential importance of recreation benefit in the economic assessment of programs such as forest recreation.

Summary and Conclusion

This paper addressed the problem of information transfer, that is, the possibility of adjusting past studies to estimate benefits for long-run policy analysis. The process involves developing an understanding of the variables that explain the observed differences in benefit estimates. As a first step, the contribution of this paper was to update and evaluate a previous literature review that adjusted reported values before presenting summary statistics. The travel time adjustment was supported by the regression results while the adjustments for sample truncation and use of the individual observation approach were somewhat lower than suggested by those results. Overall, these three adjustments were reasonably effective. There was no significant difference between the mean value of adjusted and unadjusted studies. The regression results indicated other candidates for adjustment including substitution, CVM method, site quality, administration, recreation activity, and regional location. Ideally, benefit estimates for a recreation site lacking data could be predicted by inserting appropriate values of explanatory variables into the regression. Unfortunately, an insufficient number of studies have been completed to obtain more than a few estimates of benefit by this method. Thus, it seems likely that public agencies will need to rely on a combination of several approaches until more studies have been completed.

The results presented here should be considered tentative and subject to revision with further study. Much more research is needed to fully understand the problems of information transfer. The approach illustrated here appears to be sufficiently promising to indicate that it could be used to analyze other important problems. These include adjusting for variation in the treatment of monetary and time cost of travel, substitution, site quality, and the functional form used in TCM applications. CVM problems include adjusting for variations in the method of payment, functional form used to analyze dichotomous choice questions, and information on resource quality, uncertainty, and substitution possibilities. Newer methods of controlling for the effects of these and other sources of variation in the estimates give reason to believe that it may be possible to resolve many of the problems of information transfer. It is particularly noteworthy that in both the TCM and CVM approaches, the link between consumer theory and statistical estimation may be improved via use of discrete choice and qualitative response models with maximum likelihood statistical techniques.

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