BEHAVIOURAL IMPLICATIONS OF NONMARKET VALUATION MODELS

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Abstract

A variety of methods exist for the valuation of nonmarket benefits. Some mechanisms determine these values from market data while others use hypothetical questions. This paper examines these mechanisms for valuing nonmarket goods and the attempts to validate these measures. The assumptions and implications of the nonmarket valuation techniques are examined and the various attempts at validation of the results are discussed. In light of the limitations of these validation approaches, a new validation procedure is suggested and an application is presented.

I. Introduction

The valuation of parks and outdoor recreation is necessary for the incorporation of these benefits into resource planning and decision making. The Hotelling model of valuing parks has its origins in a request from the U.S. National Parks Service to develop such values for outdoor recreation. In response to the need for such information, a myriad of valuation techniques has been developed in the past 30 years, including the contingent valuation approach and various inferential approaches. The validity of these nonmarket values has become a major question for economists and policy makers. Decision makers are often reluctant to include nonmarket values as they feel that they are too hypothetical in nature. Since there are no true values to compare with, testing the validity of the nonmarket values becomes a difficult task. From a methodological standpoint, two approaches are available, examination of the truth value of the assumptions implicit in these models and experimentation under controlled conditions. In this paper these methods of testing the validity of nonmarket values are discussed. The first section of this paper will examine various models of valuation and explicitly state their behavioural assumptions. No new concepts will be introduced in this section, rather, some new insights may be revealed. In light of the limitations in validating nonmarket values, a new approach to examining values produced by these models will be introduced and some preliminary empirical results will be presented in the latter portion of this paper.

II. Inferential Models

Valuation models based on inference from market data include travel cost models, hedonic travel cost models and discrete choice models. All of the models place different assumptions on consumer behaviour. A basic assumption of these models is that travel cost is the important variable in determining visits to particular activity sites. This in itself may be a fallacious assumption. The following section examines the behavioural implications of some of these models.

A. Assumptions

Travel cost models are the most popular form of nonmarket valuation mechanism. While a number of variants of the travel cost approach have been presented in the literature, the basic form is a regression of the number of visits to a site on the travel (and time) costs of travel to the site.

Travel cost demand curves, typically estimated as individual demands in the current literature, suggest that the demand is for trips to a particular site in a given season. However, in many forms of recreation the demand may be for time at the site. There have been several attempts at modelling the recreation demand decision as time on site, however, this form of estimation is not common. Even though the travel cost approach assumes a constant number of days per trip, it is quite common to see travel cost demands estimated for forms of recreation in which on site time varies widely among users. Alternatives to the fixed length trip approach to recreation demand include Wilman's (1987) repackaging model and Kealy and Bishop's (1986) travel cost model with days on site as the dependent variable. The issue of time on site is intertwined with issues of the opportunity cost of time and constraints on the amount of recreation time available. Some work has been done which has modeled kinks in the time budget explicitly (Bockstael, Strand and Hanemann, 1987) and some work has incorporated variables which represent these constraints in the recreation demand model (Wilman, 1987).

Travel cost models, particularly multi-site travel cost models, are examples of spatial choice models. The spatial nature of these models requires consideration of site definition and spatial cognition. Travel cost models assume perfect certainty about the conditions at the site and the travel costs. Multi-site travel cost models assume that individuals are aware of the existence and the quality of all other sites in the choice set. This choice set, however, is imposed by the researcher. Examples in the recreation literature suggest that choice of site depends on awareness and spatial cognition and not just travel cost (Perdue, 1987). Substitution between sites depends on the awareness of the substitute sites. Distance (and thus travel costs) has been found to be associated with awareness rather than the number of visits. The level of awareness, in turn, helps determine the demand (Stynes, Spotts and Strunk, 1985). Travel cost models do not allow for habit effects. In other words, the models used to estimate spatial choice and recreation demand do not allow for persistent behaviour in site choice which follows from a lack of awareness of other sites or from habits in consumption. Even the definition of a site is a difficult task. Also, many sites provide several recreation activities and recreation activities often extend over wide areas and may involve several forms of activity.

The use of discrete choice models has been increasing in the recreation literature. These models use random utility theory to develop multinomial choice models of recreation sites. These models are also essentially travel cost models as the travel costs and site characteristics are the major determinants of site choice. Nested discrete choice models have been used to estimate demands for various forms of recreation activity (different types of fishing for example) and demands with different lengths of stay (one day, two day, etc.). These models have relaxed some of the assumptions of the traditional travel cost models, however, they also impose a decision making process on the consumer. In this case, the consumer makes the choice of activity, site and duration one trip at a time. Trips are modelled as individual observations. There is no carry over of information from one trip to the next, thereby eliminating habit effects and intraseasonal factors which affect site selection. Choice sets are certain and determined by the researcher. Once again, the values provided by this technique are subject to the constraints imposed by the theoretical model used to estimate the demands.

B. Empirical Issues

A number of empirical issues also affect the values produced by the travel cost demand. A casual review of the statistical properties of travel cost demand functions shows that in most travel cost studies, very little of the variation in trips is explained by the travel and time cost regressors. Usually not more than 20 percent of the variation in trips is explained in the travel cost demand function. Perhaps one reason for the poor performance in explaining variation in trips is that the costs of lodging or supplies seldom enter the function estimating the demand for visits. In many cases these costs may be a significant determinant of the number of visits. Other possible reasons for such poor performance have been discussed elsewhere (Fletcher, Graham-Tomasi and Adamowicz, 1988).

Estimates of welfare from travel cost demands are often found to be very sensitive to specification and estimation technique. In a Bayesian sense, such sensitivity in the welfare measure in response to specification search implies a large variance on the posterior distribution of the welfare measure. The variance of the welfare measure is also affected by the choice of functional form. The welfare measure is a non-linear transformation of the demand parameters. Each functional form results in a specific transformation. The variance of these measures differs significantly among the functional forms. Adamowicz, Fletcher and Graham-Tomasi (1987) show that a high degree of confidence in the demand parameters does not necessarily lead to a low variance in the welfare measure. Kling (1988) has also analyzed the effect of functional form on the estimate of welfare and she concludes that the choice of functional form can result in "errors" in welfare measurement ranging from 4 to 107 percent. Since welfare measures are used in decision making and benefit cost analysis, the variance of the welfare measure will be an important element in the final decision of any decision maker.

The imposition of a functional form on the demand function also has implications on the underlying behaviour. Bockstael, Hanemann and Strand (1984) show that some functional forms are not integrable (cannot be derived from utility theory) while others, the double log for example, suggest that the recreation resource is essential to the consumer.

Estimates of the travel cost model also rely on the aggregation and simplification necessary in applied demand analysis. The demands are aggregated over individuals and preferences are assumed to be identical. The prices of substitutes have been stressed as important, yet, the inclusion of a full set of substitutes is impossible given the complexity of the recreation demand decision and all related activities.

The travel cost model as a valuation mechanism places a variety of constraints on the behaviour of the individuals. Constraints on the value of time, the choice of time on site, the factors that affect the number of trips, even the fact that trips in a season are chosen as the utility deriving "good", are all restrictions imposed on the system by the researcher. We know exactly what it is we are valuing with the travel cost model, but this may not be the value the consumer actually has in mind. While in some cases the assumptions of the model may be valid, in general, it is difficult to establish the validity of the values produced based on the truth of the assumptions.

III. Contingent Valuation Methods

An alternative to the demand revealing processes of travel cost and discrete choice models is the contingent valuation technique. This approach was developed explicitly to obtain values for the nonmarket services. The contingent valuation approach does not impose the constraints on the underlying choice behaviour, as do the travel cost functions. The contingent valuation mechanisms, however, suffer from a variety of problems. Hypothetical bias, strategic bias, information bias, starting point bias and vehicle bias are all forms of bias which may affect the quality of the contingent value estimates (Cummings, Brookshire and Schulze, 1986). The respondent may have a difficult task in imagining a market for the activity they are involved in, or they may not. Hunters (and most participants in consumptive forms of recreation activities) are used to paying licence fees and some private hunting areas already exist in North America. Budget cuts in the U.S. and Canada have led resource management agencies to consider user fees for such outdoor recreation activities as the use of hiking trails and cross country ski trails. Nevertheless, there are several issues which lead one to question the validity of contingent valuation results.

Three empirical issues which arise in the estimation of contingent values are, (1) the wide variance in the welfare measures, (2) the existence of protest or outlier bids, and (3) the large difference between willingness to pay and willingness to accept. The variance of the welfare measure is disconcerting as often the results are found to be not statistically different from zero. As mentioned above, the variance of the welfare measure should be an important aspect of resource decision making. The protest or outlier bids often lead one to believe that one or more of the biases inherent in the approach is being displayed. The divergence between willingness to pay and willingness to accept is also troublesome as it suggests that our welfare measures are being "clouded" by issues of rights to a resource, preference reversal or a variety of other sociological and/or economic factors.

Discrete choice analysis of closed ended contingent valuation corresponds somewhat to the constraints imposed by the travel cost approach. The aggregation problem is evident and the determination of a demand curve from the discrete choice model imposes constraints on preferences (Hanemann, 1984). Hanemann (1984) shows that the simple form of a discrete choice model used by Bishop and Heberlein (1979) can not be derived from a utility function while several forms that he provides can be derived from utility theory. Bowker and Stoll (1988) show that the welfare measures are very sensitive to these specifications of functional form and underlying preference structure.

Contingent valuation studies have been used to evaluate everything from hunting and fishing days to the value of sedimentation in the Mississippi river. They have been used to elicit option, existence and preservation values. The great degree of flexibility in these techniques will undoubtedly lead to even greater use of contingent valuation in the future. The task at hand is to determine if these values do correspond to something reasonable, in an economic context. Many policy makers and resource managers have often asked, "would the individual have really paid this amount?". In fact, the problem with all of the approaches to extramarket benefit estimation is that there are no true values to compare to these estimates. Research on the validity of these values must be an integral component of the research agenda in the nonmarket valuation area.

IV. Validity in Valuation

A number of methods of validating nonmarket values have been proposed. The most common form of "verification" of these values has been a comparison of two or more approaches (Bishop and Heberlein , 1979; Sellar, Stoll and Chavas, 1985; Brookshire *et al*, 1982; and others). A comparison is not an appropriate test of the validity of such techniques. The practice of using comparisons has been severely criticized in a recent paper by Kealy, Dovidio and Rockel (1988).

Recently, several experiments have been performed which have attempted to show that these techniques do reveal true values. Bishop and Heberlein (1986) report on the results of several experiments in which willingness to pay values from contingent valuation techniques are compared with actual cash outlays and offers. The results show that the cash and hypothetical offers in some of these experiments were not statistically significantly different from each other, while in others there was a significant difference. Examination of the results also shows that both the cash and hypothetical bids had large standard errors, often greater than twice the mean of the bids. It is difficult to draw precise conclusions from this study as the analysis is based on sample averages and the variability within the sample may be the cause of much of the confusion in the results. A study by Kealy, Dovidio and Rockel (1988) also attempts to determine how close contingent values are to actual cash outlays, this time using controlled experiments and a market good. The results of this study suggest that the difference between actual and hypothetical expenditures for a commodity may be large, even for a relatively well known market commodity. Similar research by Dickie, Fisher and Gerking (1987) suggests that differences in expenditures between hypothetical and actual markets exist although these researchers found that the demand equations constructed from the hypothetical and actual purchases did not differ significantly.

Is the difference between actual and hypothetical payments a valid approach to testing nonmarket values? These tests usually involve the comparison of mean values for a set of consumers and the significance of the results is based on the statistical difference between the two groups. An ideal test would be to subject the same consumer to the various methods of value, perhaps even in a repeated sampling process. The noise introduced by different socioeconomic characteristics, different levels of interest in the experiment and a host of other factors may be responsible for much of the variation in test results. An assumption implicit in using sample means and variances is that people's preferences are similar. In the following section a different test of nonmarket values is proposed, one which answers the question, "could these values have actually been paid by a consumer maximizing a utility function?"

V. A Test of Nonmarket Values

As suggested above, a different approach to examining the validity of the nonmarket values is to examine them in the light of all other goods and services purchased in the recreation branch of the utility function. The values that people generate should correspond to those that could have been generated by someone operating under rational choice, if indeed the individual choices are rational and the individuals are providing a consistent value. In this application we operate under a maintained hypothesis of rational choice in a recreation branch of the utility function. The recreation branch is a component of the overall utility function which exhibits weak separability. If individuals are rational, we should be able to add their reported nonmarket values on to their expenditures as if they were going to pay this amount, and result in choices consistent with rationality.

Rationality, of course, can mean many things. In this case we use the classical notion of rationality in an economic context. Rationality implies that there exists a preference ordering such that demanded bundles of goods are chosen from the budget set and this bundle is at least as preferred as any other bundle in the set. A utility function is a special kind of preference which suggests that choice of one bundle over another follows a specific form, namely the form exhibited in the utility function. Classical revealed preference theory allows us to work on observed demands and determine if these actual observations could have been generated by a consumer operating rationally. Matzkin and Richter (1987) have shown that satisfaction of the strong axiom of revealed preference (SARP) is all that is required for construction of a strictly concave utility function which acts as a representation of preferences. Varian (1982) has shown that an axiom he calls the generalized axiom of revealed preference (GARP) is sufficient for the existence of a concave utility function with the added possibility that the indifference curves may exhibit "flat spots". Tests of demanded bundles and budgets for their consistency with the axioms of revealed preference have been called nonparametric demand analysis by Varian (1982) and others. These tests allow us to determine if the bundles purchased by the consumers could have been generated by a utility function or preference relation (see Richter (1979) or Matzkin and Richter (1987) for a variety of definitions of rationality and the implications of these definitions).

The test proposed here will answer the question, "do the nonmarket value estimates and the actual budget outlays correspond to those that could have been generated by a rational consumer?" Similar tests have been performed on aggregate data (Varian, 1982; Swofford and Whitney, 1987; Chalfant and Alston, 1988) but seldom have individual data been used for such an analysis. The advantages of such an approach are that individual observations are used so no noise from aggregation is introduced and no functional forms or explicit forms of the utility function are imposed on the consumers. The main assumptions are separability of the recreation branch from all other goods (which is required so that the recreation goods can be treated as if they form a sub-utility function), and consumer rationality. These assumptions are implicit in most forms of recreation demand analysis. The preliminary results from a set of recreational hunting data are presented below.

VI. Empirical Analysis

An empirical test of the correspondence of the nonmarket values and other market expenditures on recreation trips was constructed using data from recreational sheep hunters in Alberta. These data were collected in a mail survey in 1982. The data collected included a variety of socioeconomic variables, a summary of the hunting trips taken throughout the season and the expenditures on these trips. Contingent valuation questions (willingness to pay and willingness to accept) were also included in the survey. The total number of surveys returned was 621 (a response rate of about 64%) but only 343 contained the trip and expenditure data required for the analysis. Of these 343 responses, 223 provided answers to the contingent valuation willingness to pay question and

148 provided answers to the contingent valuation willingness to accept question. The analysis was based on hunting trips to six hunting zones in the Eastern Slopes region of Alberta. These hunting zones are the administrative zones defined by the provincial wildlife management agency.

Each trip constitutes a choice occasion. This is the same decision framework used in the multinomial logit form of demand analysis. On each trip the consumer chooses the appropriate distance, number of nights of lodging, amount of food and related expenditures. These are the bundles of market goods chosen for the recreation activity. Each individual also observes market prices for these goods. The nonmarket values, and their corresponding quantities, are added to this set of market prices and the nonparametric analysis is performed on these bundles. For example, the willingness to pay question is based on a value per day. This is interpreted as a price per day for the hunting experience. These values and the number of days on each trip are added to the market purchases.

The number of hunting trips ranged from one to seven in this application. Several forms of the nonparametric tests were computed. Nonparametric tests based on willingness to pay per day, willingness to accept per season divided by the number of days, a bid function estimated from the willingness to accept compensation measure and a set of travel cost demand functions were all estimated. The travel cost demand functions are estimated using each hunting zone as a site, resulting in the estimation of six demand functions. Values per day are used in the nonparametric analysis to correspond to the assumption of each visit being a choice occasion and to provide a comparison with the contingent valuation results. Since values per day are required, the demand curve is specified with days as the dependent variable as in Kealy and Bishop (1986). The value used is the consumer's surplus per day. No multi-site effects were included in the travel cost analysis. Some results are presented in Table 1.

The first finding of interest is the large number of cases which exhibit Leontief type indifference curves. That is, even when prices change, individuals do not change their consumption bundles. About one third of the observations indicated at least two bundles which correspond with Leontief indifference curves. This result is not surprising given the lumpiness in the choice set in hunting sites and experiences. This may also be a sign of a lack of information about the goods and sites or it may be attributable to habit effects in the demand for the goods.

Turning to the number of violations of the axioms of choice, the market data alone show the highest rate of violation, although this amounted to only slightly greater than 5 percent of the number of multi-trip cases. The travel cost values and the contingent valuation mechanisms (both the willingness to pay and the willingness to accept) resulted in fewer violations of the axioms of choice. The bid function, estimated from the willingness to accept per season amounts in the fashion of Sellar, Stoll and Chavas, 1985, resulted in no violations of the axioms[1]. A Chi-squared test of proportions of violations between the various techniques is presented in Table 2. This test suggests that the number of violations in the contingent value cases is not significantly different than the number of violations in the travel cost approach. Both approaches are significantly different from the market prices alone. Further investigation of the results also suggests that one approach is not unambiguously better than the other approach for all individuals. Some individuals who violated under the willingness to pay approach did not violate under the travel cost approach, and vice versa. Future analysis of these results will include the computation of efficiency indexes which determine the severity of error for those who violate the axioms and a binary logit model attempting to explain the factors affecting violation.

VII. Conclusions

What can be concluded from such an analysis? First, the recreation demand model as formulated in most travel cost models, should attempt to model habit or uncertainty effects. The results provided here illustrate the importance of persistent or habitual behaviour. Habit effects have been the subject of analysis for a variety of other types of demand analysis including tobacco and food consumption (see Johnson, Hassan and Green, 1984). Second, if these nonmarket values were actually paid by the consumer, the demands for market and nonmarket goods could have been

[1]The approach used in Sellar, Stoll and Chavas is to estimate a bid function of the form ln(WTAC)=f(ln(Days)). The derivative of this function with respect to the quantity variable provides a price for each level of days.

generated by a rational consumer. In other words, under a maintained hypothesis of rationality, the prices provided by the nonmarket value techniques coincide with rational choice of market and nonmarket goods. In one sense this makes the values seem quite reasonable in the context of recreation choice. On the other hand, there is considerable variation in the values chosen, most of which are still consistent with the axioms of choice. Since consumers are not given these "prices", they make a choice, hopefully based on what is rational to them. However, there may be a wide variety of prices that are consistent with rationality. Perhaps this helps to explain the large variances in contingent valuation results. There may be little chance of obtaining a narrow band of nonmarket values. However, this does not detract from the need to collect accurate and detailed information on nonmarket values. As well, further research on the validity of these values is essential to their acceptance and use by decision makers.

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Table 1: Results of the Nonparametric Analysis

	WTP[a]	WTAC[b]	WTAC[c]	Travel Cost[d]	Market Prices[e]
Percentage of Violations	1.19	0.88	0.00	1.51	5.30
Total Number of Individuals	223	148	148	343	343
Total Number of Choice Occasions	706	456	456	1125	1125
Cases with Leontief Curves	73	44	44	114	114

a Willingness to pay values as nonmarket prices.
b Willingness to accept per day as nonmarket prices.
c Bid function of the form WTAC = f(Days) used to derive demand curve and marginal willingness to pay per day.
d Travel cost demand functions estimated, semi-log form, time valued at the wage rate. Values per day used as nonmarket prices.
e No nonmarket prices are included, only market prices are used.

Table 2: Statistical Test[a] of the Comparison of the Number of Violations Between Nonmarket Methods

Comparison	Chi Squared Value	P-Value
Market Prices vs CV(WTP)	4.999	.025
Market Prices vs CV(WTAC)	4.050	.044
Market Prices vs BF(DAYS)[b]	6.218	.013
Market Prices vs Travel Cost[c]	5.705	.017
CV(WTP) vs CV(WTAC)	0.039	.844
CV(WTP) vs BF(DAYS)[b]	1.334	.248
CV(WTP) vs Travel Cost[c]	0.093	.760
CV(WTAC) vs BF(DAYS)[b]	1.003	.316
CV(WTAC) vs Travel Cost[c]	0.247	.619
BF[b] vs Travel Cost[c]	1.740	.187

a Chi Squared test statistic.
b Bid function of the form WTAC = f(Days).
c Semi-log functional form, value of time as the wage rate.