DRAFT--Please Do Not Cite
Comments Welcome

Combining Behavioral and Conversational Approaches To Value Amenities: An Application to Gray Whale Population Enhancement

Douglas M. Larson, John B. Loomis, and Yu-Lan Chien*

July 1993

Contributed Paper for the AERE Session
"Reliability and Validity of CV Methods"
American Agricultural Economics Association Annual Meeting
Orlando, Florida
August 1-4, 1993

*Department of Agricultural Economics, University of California, Davis; Department of Agricultural and Resource Economics, Colorado State University; and Department of Agricultural Economics, University of California, Davis, CA 95616. Support for this work by the Resources for the Future Small Grants Program and the U.S. Environmental Protection Agency, Office of Exploratory Research, is gratefully acknowledged. Thanks go to Renatte Hageman, San Diego State University, for overseeing the data collection in San Diego, and to Paula Stevens, UC Davis, for supervising data collection and input for Northern California locations.

Combining Behavioral and Conversational Approaches To Value Amenities: An Application to Gray Whale Population Enhancement

The nature and scope of many contemporary environmental problems have prompted a keen interest in methods for evaluating the economic benefits provided by environmental amenities such as clean air, water, and coastline. Because these amenities are typically not "marketed" in any usual sense, it is more challenging and problemmatical to infer peoples' values for such amenities since there are no easily observable prices to signal their marginal values. Two broad approaches have been used in attempts to the non-market benefits of enhancing environmental quality, the contingent valuation method (CVM) and the travel cost method (TCM). The CVM is a direct approach to valuation, relying on interviews with respondents in which scenarios involving public good provision are developed and values elicited directly (the standard reference is Mitchell and Carson). The TCM, in contrast, is an indirect method which attempts to infer peoples' valuations from their behavior, by estimating demand functions for privately-marketed goods related to peoples' enjoyment of the amenity of interest. Each has strengths and weaknessess: the CVM is relatively easy to use but requires we accept at face value that what people say (regarding values they would be willing to pay) is in fact what they would do if a market test were available. Some argue that a CVM response represents the satisfaction of having contributed to a cause, or "warm glow," rather than any meaningful estimate of actual willingness to pay for differing levels of an amenity (e.g., Kahneman and Knetsch). The principle behind the TCM, which is recording behavior and inferring value from it, is preferred by many economists, but empirical travel cost demand studies require a large number of judgements, many of them *ad hoc* in nature, which can have a major impact on the results obtained. TCM studies typically also rely on what people say, about their behavior or activities rather than their willingness to pay.

Another, relatively recent issue highlights a difference in the scope of the two methods. Prominent pollution incidents such as increased haze and smog over the Grand Canyon from emissions of the Navajo Generating Station, or the grounding of the *Exxon Valdez* in Prince William Sound, have raised the prospect that those affected may extend far beyond the population of direct "users," or those who have contact with the amenity through travel to engage in recreation in the area. Even those who do not plan to visit the Grand Canyon or Prince William Sound may be affected by the pollution, and be willing to pay to reduce it. To the extent that nonusers also have relevant, admissible values associated with the environmental amenity, their sheer numbers alone may represent a significant source of economic value. For these people, however, there is not an obvious behavior that is easily observed (such as travel to a recreation site), so the TCM cannot be applied in any obvious way. However, the CVM can be used for these people in much the same way that it can be for users.

For these reasons, there has been awareness for some time that neither model dominates the other, and that they should be viewed as complementary sources of information about peoples' values of environmental amenities. Several studies have attempted tests or comparisons of the valuation estimates derived by both methods applied to the same valuation problem (e.g., Bishop and Heberlein; Sellar, Stoll and Chavas; Smith, Desvousges, and Fisher; Boyle and Bishop), but only recently have such tests been conducted within a consistent utility-theoretic and stochastic structure. Cameron specifies a quadratic direct utility function and derives the associated demands and compensating variations, which are then estimated jointly. While this represents a significant advance, she notes that the choice of a quadratic direct utility function is not compatible with the stochastic structure assumed in the model. Larson (1990) begins with several commonly-estimated simple functional forms for demands, and derives the functional form and error structure of willingness to pay from the functional form and error structure of demand. A limitation of this approach, though, is that the simple linear or linear-in-logs demand specifications are quite inflexible and lead to willingness to pay (WTP) relationships highly nonlinear in parameters, ruling out standard software packages for estimation.

The purpose of this paper is to report on work in progress that attempts to build on the general approach explored by Cameron and by Larson (1990) of combining information from TCM and CVM for purposes of developing better estimates of economic value associated with environmental amenities. The amenity in question is enhancements of gray whale populations off California, which is a well-known and well-defined resource that supports a significant recreational whale-watching activity. "Users," in our study, are those who have direct contact with whale populations by viewing their annual migration offshore; they have an observable behavioral trail for demand estimation because of the need to travel to the coast to observe the migration. Nonusers are potentially of two types: either they are "potential users," who are out of the market because of price (or income, or quality); or they are truly nonusers, who under no circumstances would watch whales or value enhancements in their population.

There are several innovations in this work. First, we combine TCM and CVM information obtained from both users and nonusers of an environmental amenity, which will allow us to evaluate whether potential users can be considered to have the same preferences as current users.[1] However, this effort toward joint estimation is different from previous efforts, which have considered two sources of information about the valuations associated with changes in *price*. These past studies combined estimates of WTP for provision or removal of a good such as recreational fishing with the estimates of consumer's surplus (or more precisely, compensating variation) from the demand function. The two sources of information provide what should be the same number, aside from sampling and specification error. The CVM estimate is interpreted, typically, as the compensating variation for a price change from a reference level to the level that chokes off demand (or vice versa); in theory, this should be the same as the area to the left of the Hicksian demand curve above the price line.

In this work, we instead combine information of two types: a demand function that captures behavior with respect to different price levels, since different individuals represented in the demand function come from different distances to engage in whalewatching, and CVM information on willingness to pay for different levels of *quality*, as represented by changes in the population of whales offshore and in whale sightings. The CVM information, when incorporated into the preference structure along with the demand information, has the effect of "pinning down" preferences with respect to the quality dimension

Normally all that can be inferred by working with demand functions alone is the quasi-expenditure function $\tilde{c}(p,z,\theta(z,w,u))$ (e.g., Hausman) up to a constant of integration $\theta(z,w,u)$, where z is the environmental quality or amenity of interest and w is a vector of other shifters. The only things known *not* to be in $\theta(z,w,u)$ are the prices p used in integrating back. However, by introducing CVM information on willingness to pay for changes in quality, it is possible in principle to identify the curvature of $\theta(z,w,u)$ in z and thereby complete the picture of how preferences depend on the environmental amenity. This in turn permits one to calculate welfare measures which represent the individual's full valuation of the amenity. While other forms of the integration constant would also be constant with observed demand behavior, they can be evaluated and rejected or accepted statistically in the joint estimation approach.

A second innovation is in estimation. We use an AIDS specification for demand (Deaton and Muellbauer), which is more flexible and easier to estimate than the linear and linear-in-logs forms. The functional forms and stochastic structure of the joint errors on willingness to pay and demand are all consistent, and the model can be estimated fairly easily. Third, we test for whether the economic value associated with the individual's behavior and/or willingness to pay bid is motivated by use value, nonuse value, or both. Finally, we develop a test for the presence of "warm glow." If it is present, the individual's stated willingness to pay can be adjusted for this source of satisfaction from the act of giving itself, and "true" marginal values of the amenity calculated.

The result of all this is that using the two sources of information, one can account for how much of an individual's CVM bid is actual compensating variation from changes in the level of the amenity (and whether it is motivated by use value, nonuse value, or both) and how much is warm glow; further work will enable us to evaluate whether it is reasonable to characterize potential and actual users as having the same preferences or not.

The Empirical Setting

Gray whales are a prominent marine population off the west coast of the United States, and their annual migration from summer grounds in the Bering Sea to Baja California for winter calving and rearing is well-documented and well defined in time and space. Particularly on the southward leg of the migration, which is typically nearer shore, the gray whales attract a substantial interest in whale viewing. There are both opportunities for viewing at prominent California shore locations such as Point Reyes and Point Loma, and a significant industry involving boats which take viewers on gray whale viewing trips, from December to March of each season.

The survey instrument was developed to allow collection of data to support both TCM and CVM modelling, for samples drawn from both whalewatchers and from California households. Thus questions on number of trips so far that season, expected future trips, travel time, travel costs, whether the trip was their primary destination, etc., were asked. Other information included actual contributions to marine mammal groups, time spent reading, watching, or thinking about wildlife and whales, as well as purchases of whale-related merchandise. Demographic information including work status, wage rates, income, paid vacation time, and when people choose to go whalewatching, was also collected.

The payment vehicle for the CVM exercise was payment into a gray Whale Protection Fund, a dedicated fund whose purpose is the enhancement of gray whale populations. The survey stated that "Legally the money could only be used to clean up coastal waters of pollution and drift nets, purchase additional calving habitat areas, etc." Individuals were first asked their WTP for a 50% increase in population size, then asked questions concerning WTP for a 100% increase over current population levels. Questions were included to determine whether persons stating zero WTP were protesting some feature of the CVM market, and whether those who were not currently whalewatchers would ever do so.

A draft of the survey instrument was pretested using individuals who had gone whale watching in the previous year. A survey was given or mailed to them and they were asked to fill it out and make addtional comments on the questions and format. During this pretest open-ended WTP responses were collected and used as a basis for determining bid amounts for the dichotomous-choice bid amounts. Based on the pretest, two sets of bar charts were added to illustrate what a 50% and a 100% increase in gray whale populations would represent relative to the current situation.

Visitor Sample Frame

The visitor sample frame is defined by both time and space. We sampled over the months of the gray whale migration along the California coast. Whales start arriving in northern California in late December and migrate south to San Diego and Baja California during January. Then in February whales begin to migrate back north, passing through northern California by late March or early April. Many people taking trips to the coast during these months are out to view whales rather than for traditional summertime ocean-related activities. To be cost-effective in sampling, we sampled weekends and holidays at the locations described below. The choice of whether to sample on Saturday or Sunday was random, bit did allow for a balance of Saturdays and Sundays.

The visitor intercept survey took place at four locations along the California coast: San Diego (Point Loma National Seashore), Monterey, Half Moon Bay (south of San Francisco), and Pioint Reyes National Seashore (north of San Francisco). At Point Loma and Point Reyes people intercepted were viewing whales from the shore, whereas people intercepted at Monterey and Half Moon Bay had just disembarked from 2-6 hour cruises being run at that time of the year by commercial operators specifically for whale watching. This choice of sampling sites enabled us to sample people using both modes (shore watching and boat trips) of whale viewing.

Visitor Data Collection Procedures

Survey administration for visitor intercepts was as followed. Every n^{th} adult visitor (age 16 or older) was contracted by one of our trained interviewers. For boat trips n equaled 5 and for shore intercepts n equaled 10.) Interviewers were dressed in

University of California jackets with "Whale Watching Survey" in large letters on the back, and also wore University of California nametags identifying them. The interviewer introduced him- or herself to the visitor, explained the purpose of the survey, answered any questions about the project or mechanics of completing the survey, and asked the visitor to take home a self-explanatory packet which included a mail survey to be returned. Interviewers also recorded names and addresses of visitors contacted for followup mailings if necessary. The take-home packet included a cover letter, the questionnaire, and a postage-paid return envelope.

We chose this survey administration mode because it combined the best of personal interview and mail questionnaire techniques. The personal contact allowed the interviewer to stress the importance of the respondent to the representativeness and completeness of the study, and to obtain a "good faith" committment to return the survey. The interviewer was able to answer any concerns the visitor had about the survey or how they were selected to participate. By giving them the survey after they finished the trip (rather than mailing it to them) they could record their trip details while on the drive back home or shortly after the trip.

However, we did not think it desirable to conduct personal interviews at the intercept site itself, for several reasons. First, weather at the coast in the winter is not always conducive to lengthy outdoor interviews, and weather-proof shelter for interviewing was not available at the interview sites. Also, some passengers disembarking from boat trips, particularly at Half Moon Bay, were not in good physical or mental condition to answer detailed questions about their trip and to evaluate thought-provoking cvm scenarios. By giving the questionnaire to the visitor after a brief explanation of its purpose and their importance to the study, they could devote adequate thought to answering the variety of questions concerning their activities and their valuations of whale-related recreation at their own pace.

In total, 1,402 surveys were handed out, and 1,003 were returned, for an overall response rate of 71.3%. The response rate was reasonably similar across the four locations, varying from a low of 65.2% for intercepts at Point Loma (San Diego) to a high of 80.3% for intercepts at Point Reyes. On-site refusals were not a problem. For example, at Point Reyes, only 10 people of roughly 600 contacted (about 1.6%) refused to take a survey packet.

Household Survey Design

A second survey was also conducted of households in California, for the purpose of collecting information from individuals who are not avid whale watchers and who have never been to the coast for the purpose of whale-watching (and therefore are not considered "users" of gray whale populations in any direct sense). The content of this survey was very similar to that of the survey administered to visitors, with two important exceptions. First, there was less information requested on whale viewing trips. Second, this information was placed later in the survey. Otherwise, identical questions were used about demographics, interest in outdoor activities and environmental issues, purchases of whale-related items, and the cvm valuations of whale population increases. This was done to maintain consistency between visitor and household surveys.

Household Survey Data Collection Procedures

A stratified sample of California households was purchased from Survey Sampling Inc. The sample was stratified between persons living in counties adjacent to the California coast and those living in inland counties. Given that the California population distribution is heavily centered along the coast, a simple random sample would not have given us an adequate number of non-coastal residents to permit statements about this group.

A total of 2,000 names and addresses were obtained. Following Dillman, a personally-addressed cover letter (with original signature) and postage-paid return enveloped accompanied the questionnaire. We also attached a dollar bill to the survey as a token of appreciation; this has been shown to be a very cost-effective way of enhancing response rates because acceptance of the token monetary amount frequently creates a good-faith committment to participate. This first mailing was followed up with a reminder postcard one week later. Then a second mailing (without the dollar bill) was sent to nonrespondents. Finally, a random sample of non-respondents was phoned. The purpose of this was to ascertain whether they had received the survey, whether it had been recently returned, and whether they would respond to another mailing. We also noted whether there was any difficulty with understanding English language mailing or conversations, which were fewer than we expected given California's multiculturalism. We asked people who refused to return another mailing whether they had ever been whale-watching and their educational level, for comparison with respondents. As we expected, non-responding households had a slightly lower education level and were less likely to have been whale-watching compared to responding households.

Of 2,000 household surveys, 301 were undeliverable, 41 were addressed to deceased people, and 16 were addressed to businesses or government agencies. Of the eligible sample of 1,642, 883 questionnaires were returned in the first and second mailings. The overall response rate for deliverable questionnaires was 54%, slightly above the average for other mail CVM surveys in California (Loomis, 1987).

Defining the Data Set for This Analysis

In defining the data set for the preliminary analysis in this paper, from the user sample only those who took a whalewatching trip for the primary purpose of viewing whales were used. (Some 550 of those intercepted indicated that their trip was incidental or for multiple purposes.) From both user and household samples, observations with missing data on income, expected whale sightings, or willingness to pay were also not used. This resulted in a data set with 894 observations.

Of the 894 people in the data set, 135 were classified as "nonusers" based on their responses in the negative to questions about whether they would under any circumstances (i.e, for a zero price) go whalewatching. Of the remaining 759 observations, some 335 people were "users" of whale populations because they had taken at least one primary-purpose whalewatching trip in the 1992 season. A total of 258 people had not gone whalewatching but expressed a positive willingness to pay for whale population increases, and were considered "potential users" in that they could become a whalewatcher if the price of access were lower or expected quality were higher. Another 166 were also potential users (in that they did not rule out the possibility of becoming a whalewatcher) but took no trips and expressed zero willingness to pay, so there was no behavior nor stated intentions to use in estimating preferences. Thus, of the 894 people in the sample, 593 people had actual behavior or stated intentions of valuing whales, while 759 in total were users or potential users. The remaining 135 would, by their own statements, never be in the "market" for whales. For this analysis, we focus on the 759 users and potential users for estimating the determinants of participation in whalewatching, and use the 593 observations for which there was observable behavior (whalewatching trips taken) or stated intentions of valuing whales (positive willingness to pay) in estimating the joint behavior-valuation system.

Time prices (travel time) and time budgets (a measure of discretionary time available for whalewatching) were collected. It was assumed that an individual's whalewatching choice is a short-run decision conditional on his or her long run labor-leisure choice, and that work time is not a source of utility or disutility, as many (e.g., Bockstael, Strand, and Hanemann) have argued is reasonable. Under these conditions, Larson (1993) shows that the relevant shadow value of time is the wage rate whether or not the individual is working fixed or variable weeks. Thus, the price and income variables used in the analysis were "full" price and "full" income, with time valued at the wage rate. For nonusers, both miles traveled and travel time to the nearest whalewatching site was estimated by use of PCMILER, and travel costs were estimated as the product of miles travelled and the mean money costs of travel per mile for users. As whalewatching trips are all day trips, the length of stay onsite was taken as exogenous[2] and the marginal price of a trip was the total time (travel plus time spent whalewatching) spent on the trip valued at the wage rate, plus the total money costs of travel and while onsite.

Table 1 presents summary statistics for the key variables in the analysis, both for the full sample used in the estimated behavior-valuation system and for the users and potential users in that sample. Prices and income include time valued at the wage rate, and are comparable for both subsamples. Users reported expecting to see about twice the number of whales on a whalewatching trip than those who were not whalewatchers, and users scored higher on an avidity index composed of the mean of responses to 4 intensity questions (3 with 1=low, 4=high and the other with a 0-3 scale) relating to whales and the marine environment. Age, number of wage earners in the household, and education level, and miles from the home to a whalewatching site were all comparable, though the user sample was made up more heavily of men than the general household sample. The overall mean willingness to pay was \$26 for a 50% increase in whale population size, and \$29 for a doubling of population, with users stating they were willing to pay approximately \$4-5 more on average than potential users. A few people from out of state listed very high mileages from their homes to the whalewatching site, but were asked on the survey for their marginal trip costs from their instate location to the whalewatching site.

An AIDS- Based Demand and Valuation Model

A framework which is to be used for combining information at the level of behavior or demand with information at the level of value or willingness to pay should be capable of generating compatible functional forms and stochastic structures for the estimating equations. Consider the following simple cost function, based on the AIDS model with a quality variable:

$$\text{(1)}\qquad \log c(p,z,u) = \alpha_0 + \left\{\alpha_1 + \alpha_z \log(z) + \frac{\sigma\epsilon}{1-\beta_1\log(p)}\right\}\log(p) + \frac{\gamma_{11}}{2}[\log(p)]^2$$

$$+uz^{\phi}p^{\beta_1}$$

where p is the price of the good of interest whose demand is being measured, z is an exogenous quality variable, u is an index of utility, ϵ is a N(0,1) error, and σ is the standard error. This cost function is derived from an incomplete (Marshallian) demand system for a single good x(p,z,y), where y is total income (not expenditure share) Using weak integrability (e.g., LaFrance and Hanemann), all other goods are aggregated into a composite good with normalized price of 1. This simple formulation is used in our setting where only a single good will be in the empirical demand system; it generalizes readily to many-good systems.

The Hicksian budget share, w^h, is obtained from the derivative of (1) with respect log(p) and using Shephard's Lemma, which yields

$$\text{(2)}\qquad w^h = \alpha_1 + \alpha_z \log(z) + \gamma_{11}\log(p) + \beta_1 uz^{\phi}p^{\beta_1} + \frac{\sigma\epsilon}{1-\beta_1\log(p)}.$$

Inverting (1) with respect to utility to obtain the indirect utility function,

$$\text{(3)}\qquad v(p,z,y) = \left\{\log y_0 - \alpha_0 - [\alpha_1 + \alpha_z \log(z)]\log(p) - \frac{\gamma_{11}}{2}[\log(p)]^2\right\}/z^{\phi}p^{\beta_1}$$

$$+ \left\{\log(p)/\left([1-\beta_1\log(p)]z^{\phi}p^{\beta_1}\right)\right\}\sigma\epsilon,$$

and substituting this into (2) gives the Marshallian budget share

$$\text{(4)}\qquad w = \alpha_1 + \alpha_z \log(z) + \gamma_{11}\log(p) + \beta_1\log(y/P) - \beta_1\alpha_z\log(z)\log(p) + \sigma\epsilon$$

where P is a price index. In the application discussed here, we follow the lead of much of the empirical demand literature and take P to be Stone's price index (e.g., Green and Alston), which in this simple model is $P=p^w$.

In addition to information on demand for whalewatching, the mail survey also collected information on individuals' willingness to pay for enhancements in the population of gray whales migrating off the California coast. In the survey, two improvements in quality were posited: a 50% increase in gray whale populations ($z=z_1$) and a 100% increase ($z=z_2$). It was explained that these population increases would translate to comparable increases in whale sightings on whale-watching trips.

Individuals were also queried about their expected whale sightings when (and if) they took a whalewatching trip. Thus, while individuals differed with respect to their reference level z_0, since individual expectations about whale sightings varied across the sample, the ratio $z_1/z_0 = 1.5$ and $z_2/z_0 = 2.0$ were constant for all in the sample.

The implications of (1) for the form of willingness to pay for quality changes are as follows. When the quality variable z changes, to z_1, say, the minimum expenditure required to maintain utility is, from (1),

$$\log c(p,z_1,u) = \alpha_0 + \left\{\alpha_1 + \alpha_z \log(z_1) + \frac{\sigma\epsilon}{1-\beta_1 \log(p)}\right\} \log(p) + \frac{\gamma_{11}}{2} [\log(p)]^2$$
$$+ u z_1^{\phi} p^{\beta_1}$$

and the difference in log expenditure required to maintain utility is

$$\log\left\{c(p,z_1,u) - c(p,z_0,u)\right\} = \log \frac{c(p,z_1,u)}{y_0}$$
$$= \alpha_z \log(p) \log(z_1/z_0) + u p^{\beta_1}(z_1^{\phi} - z_0^{\phi})$$

where y_0 is the reference level of minimum expenditure, which is the individual's money income. This is easily manipulated to identify an expression for subsequent minimum expenditure required to maintain utility in light of the quality change,

(5) $$c(p,z_1,u) = y_0 \exp\left\{\alpha_z \log(p) \log(z_1/z_0) + u p^{\beta_1}(z_1^{\phi} - z_0^{\phi})\right\}.$$

From (5), it is straightforward to identify the willingness to pay for the quality change from z_0 to z_1, a compensating variation measure, as

$$wp_1 = y_0 - c(p,z_1,u)$$
$$= y_0 \left\{ 1 - \exp\left(\alpha_z \log(p) \log(z_1/z_0) + u p^{\beta_1}(z_1^{\phi} - z_0^{\phi})\right)\right\}$$

or rearranging to express willingness to pay for the quality change in a form that it more convenient for estimation,

(6) $$\log\left(1 - \frac{wp_1}{y_0}\right) = \alpha_z \log(p) \log(z_1/z_0) + u p^{\beta_1}(z_1^{\phi} - z_0^{\phi}).$$

It should be noted that (6) is a stochastic specification, because the utility index $u \equiv v(p,z,y)$ is a random variable due to incomplete observation of choice determinants by the researcher. Substituting the indirect utility function from (3) into (6), the estimating equation for willingness to pay is

$$\text{(7)} \qquad \log\left(1-\frac{wp_1}{y_0}\right) = \alpha_z \log(p)\log(z_1/z_0) + [(z_1/z_0)^{\phi}-1]\log(y_0/P) - \alpha_z[(z_1/z_0)^{\phi}-1]\log(p)\log(z_0) + \frac{\log(p)}{1-\beta_1\log(p)}\sigma_1\epsilon,$$

where $\sigma_1 \equiv [1-(z_1/z_0)^{\phi}]\sigma$ is the standard error of the willingness to pay for z_1. In equation (7), $z_1=1.5\cdot z_0$ represents a 50% increase in gray whale populations, and wp_1 is the corresponding willingness to pay (compensating variation). A similar line of reasoning for the other postulated quality change, $z_2=2\cdot z_0$, leads to the third estimating equation,

$$\text{(8)} \qquad \log\left(1-\frac{wp_2}{y_0}\right) = \alpha_z \log(p)\log(z_2/z_0) + [(z_2/z_0)^{\phi}-1]\log(y_0/P) - \alpha_z[(z_2/z_0)^{\phi}-1]\log(p)\log(z_0) + \frac{\log(p)}{1-\beta_1\log(p)}\sigma_2\epsilon.$$

where $\sigma_2 \equiv [1-(z_2/z_0)^{\phi}]\sigma$.

The nonlinear system of equations to be estimated consists of (4), (7), and (8), with a modification to account for the possibility of "warm glow" which is discussed below. Several points about this system should be noted. First, the parameter ϕ, if statistically significant, expresses the nonuse-related motivations individuals may have with respect to enhancing whale populations. This parameter is part of the preference function but does not appear in the demand for whalewatching; thus, working back from whalewatching demand alone, ϕ could not be recovered and thus is a source of value from whale population enhancements that is unrelated to direct use through whalewatching. These nonuse-related motivations are expected not to decrease the value an individual derives from whale population enhancements. It can be seen from (5) that this implies $\phi \leq 0$ when the utility index u is positive, as is typically the case in the AIDS model.[3]

Similarly, the parameter α_z is the source of value from whale population increases that results from increased "use" of whales or, in this context, from increased whalewatching as the population of whales migrating off the coast increases. One would expect $\alpha_z>0$ if increases in whale population increase the (Hicksian) demand for whalewatching.

Third, one would expect the willingness to pay equations to be heteroskedastic, with an adjustment factor of $[\log(p)/(1-\beta_1\log(p)]^{-1}$ needed to make each willingness to pay error homoskedastic. The potential heteroskedasticity arises since the price of whalewatching, p, varies across the sample, and the error terms in (7) and (8) each contain the term $[\log(p)/(1-\beta_1\log(p)]$.

Testing for Warm Glow

One of the arguments made against CVM as a legitimate valuation method is that it may express only individuals' satisfaction derived from giving to an important cause, and not the value they derive from actual increases in the public good or amenity being valued (Kahneman; Kahneman and Knetsch). In models of charitable giving such as that proposed by Andreoni, individuals are classified as "altruists" if they get no personal gain from contributing to an increase in a public good, and as "egoists" if the utility they receive from giving comes solely from the satisfaction of giving itself. In general, individuals may express values for increases in public goods that come from both sources.

It has been shown by Larson and Loomis (1993a) that in a model of charitable giving following the Andreoni model, if the marginal utilities of giving and of income are constant, warm glow will be a constant. This is probably reasonable in many valuation contexts involving public goods and environmental amenities, because the incremental value associated with increased provision of the amenity (and the corresponding willingness to pay) are very small relative to income. For example, in our sample, peoples' money incomes were approximately \$48,000 (while their full incomes were approximately \$66,000), and the mean willingness to pay was on the order of \$20-\$30. It seems quite reasonable in this case to assume that marginal utilities of giving and of income are constant.

The implication of warm glow in peoples' responses is that each willingness to pay equation will contain a constant unrelated to the quantity of the public good provided. This means that (7) and (8) become

$$(7') \qquad \log\left(1-\frac{wp_1}{y_0}\right) = \psi + \alpha_z \log(p)\log(z_1/z_0) + [(z_1/z_0)^{\phi}-1]\log(y_0/P)$$

$$- \alpha_z[(z_1/z_0)^{\phi}-1]\log(p)\log(z_0) + \frac{\log(p)}{1-\beta_1\log(p)}\sigma_1\epsilon,$$

and

$$(8') \qquad \log\left(1-\frac{wp_2}{y_0}\right) = \psi + \alpha_z \log(p)\log(z_2/z_0) + [(z_2/z_0)^{\phi}-1]\log(y_0/P)$$

$$- \alpha_z[(z_2/z_0)^{\phi}-1]\log(p)\log(z_0) + \frac{\log(p)}{1-\beta_1\log(p)}\sigma_2\epsilon.$$

where ψ is warm glow, the same magnitude in both equations to reflect the satisfaction from giving that is unrelated to changes in public goods. It can be seen from both (7′) and (8′) that when the change in public good is zero (z_0=z_1=z_2), the valuations would be

$$(7'') \qquad \log\left(1-\frac{wp_1}{y_0}\right) = \psi$$

and

$$(8'') \qquad \log\left(1-\frac{wp_2}{y_0}\right) = \psi$$

since all other terms, including the stochastic term, zero out. The test for the presence of warm glow is whether ψ is significantly different from zero. If ψ is statistically significant, then from either (7″) or (8″) it can be seen that warm glow varies with income, and can be written

$$(9) \qquad \text{Warm Glow} = wp_1|_{\triangle z=0} \;=\; y_0(1-e^{\psi}),$$

so the expectation is that with a positive warm glow, $\psi \le 0$.

Accounting for Sample Selection

Since our sample consists of both "users," for whom whalewatching demand is positive, and "nonusers" who have zero quantity demanded, censoring of the observed share-willingness to pay system must be treated. Among the 759 observations in the data set for estimation, 335 were users and 424 were potential users. This censoring on the behavioral relationship (demand for whalewatching) suggests the need to account for why people are users (i.e., in the "market" for whalewatching) as well as their specific quantities of use and willingness to pay for increases in whale populations. The censoring on the behavioral relationship also could affect the observed willingness to pay for nonusers, in that different preferences (i.e., a different parameter vector) could characterize potential users.

In light of these factors, consider the following model. Let I^* be a latent variable determining participation in whalewatching, with

$$I^* = \xi X + u$$

where X is a set of participation determinants, ξ is a corresponding parameter vector, and u is a N(0,1) error. What is observed is the indicator variable I, with

$$\begin{array}{l} I = 1 \text{ when } I^* > 0 \\ I = 0 \text{ when } I^* \leq 0, \end{array}$$

and the corresponding systems of behavior and willingness to pay for the 593 observations with positive trips or willingness to pay (or both) is

$$\text{(10)} \qquad \left.\begin{array}{l} w = f(Y,\epsilon;\, \delta^u) \\ wp_1 = f_1(Y,\epsilon_1;\, \delta^u) \\ wp_2 = f_2(Y,\epsilon_2;\, \delta^u) \end{array}\right\} \text{ when I=1}$$

and

$$\text{(11)} \qquad \left.\begin{array}{l} w = 0 \\ wp_1 = f_1(Y,\epsilon_1;\, \delta^p) \\ wp_2 = f_2(Y,\epsilon_2;\, \delta^p) \end{array}\right\} \text{ when I=0}$$

where $f(\cdot)$, $f_1(\cdot)$, and $f_2(\cdot)$ are the share and two willingness to pay equations (4), (7′), and (8′), Y is the set of all explanatory variables, and δ^u and δ^p are parameter vectors for users and potential users, respectively. In the "separate preferences" model, δ^u and δ^p in (10) and (11) were each estimated using the Inverse Mills ratio as a separate regressor to account for the non-zero expectation of the error in the share (participation) decision, while in the restricted model (10) and (11) were estimated jointly with $\delta^u = \delta^p$. While this approach accounts for censoring on the share equation as it affects the observed system, it is essentially *ad hoc* in that the participation (probit) equation not formally derived from (4), (7′), and (8′). It also does not use the information from the first stage probit on the 166 potential users who had both trips and willingness to pay equal to zero. Making the participation and continuous quantity decisions fully compatible is a subject for further work.

Results

Results of the first-stage probit equation are given in Table 2. In this model, users and nonusers were assigned weights consistent with their representation in the population, which the general household survey revealed. Explanatory variables include the natural logaritms of income, quality (expected whale sightings), avidity, gender, age, and distance from the individual's home to the nearest whalewatching site. Income, avidity, and quality had the expected positive effects on the probability of being a user, and distance had the expected negative effect; all were significant at the 95% confidence level for a one-tailed test. This model is not ideal in some important respects, however. While the determinants of participation all have plausible signs, the model does not predict participation well (though it does predict nonparticipants well). Nearly all (57/59) of the users in the weighted model were predicted to be potential users, while 698 of 700 potential users were predicted correctly. The pseudo-R^2 measures of goodness of fit indicate that the overall explanatory power is not strong, though a likelihood ratio test on the model as a whole indicates that the set of explanatory variables are highly significant in predicting the probability of participation.

Table 3 presents the results of estimating (4), (7′), and (8′) as a nonlinear system, using the NL routine in the SHAZAM mainframe version 7 (White). The model was first estimated assuming homoskedastic errors on the willingness to pay equations to get a consistent estimate of the income elasticity (β_1), then the willingness to pay equations were corrected for heteroskedasticity evident in (7′) and (8′). The willingness to pay errors, not surprisingly, were highly correlated ($\rho_{12} \doteq .92$-$.97$), while the correlations between each willingness to pay equation and the share equation were not high (ρ_{w1} and ρ_{w2} ranging from approximately -.23 to -.26). Censoring did not appear to be a major problem within the unrestricted model, as the coefficients on the Inverse Mills ratio from the participation model in each equation ($\lambda_1 - \lambda_3$) were not statistically significant at the 5% level; however, in the joint model the IMR was significant in both willingness to pay equations but not in the demand equation.

The first set of parameter estimates (in Model 1) is from the "separate preferences" model, where separate parameter vectors are estimated for users and potential users. Model 2 assumes they have the same preferences. In both models, the results conform with *a priori* expectations about signs and are highly significant. At the means, the coefficients in the share equations imply that Marshallian and Hicksian own-price elasticities of demand are negative, and the Marshallian income elasticity is positive; all are statistically significant at the 5% level and imply own-price and income elasticities of approximately $.45-.50$. For users in the unrestricted model, the quality coefficient in the demand for whalewatching is not significant, though the nonuse parameter ϕ is highly significant with the expected (negative) sign. For nonusers in the unrestricted model and for the joint model, each of the use-related parameter α_z and the nonuse parameter (ϕ) and warm glow parameter (ψ) are significant statistically, with the expected signs. The warm glow, parameter, ψ, is highly significant and stable across specifications; this suggests the importance of testing for and removing warm glow from the value estimates implied by a CVM model.

A natural question that arises is whether the "separate preferences" or "joint preferences" model is preferred. It is not possible as yet to do a likelihood ratio test to evaluate the null hypothesis that preferences are identical between the two groups; the likelihood function values are higher in the "restricted" model than in the "unrestricted" model, for reasons that are not yet clear. Whether this is due to the separate preferences model not converging at a global maximum or due to different scalings of the likelihood function in the separate estimation runs is not known as of this writing. A qualitative examination of the parameters in common between the user and potential user models shows that the warm glow parameter is very stable across specifications, while the quality parameter α_z varies by a factor of about 3 betweeen users and nonusers while the nonuse parameter ϕ varies by about a factor of 2. IF a formal test were to reject the joint model, this would suggest that potential users are not "out of the market" simply for reasons of price; systematic differences in preferences are also at work. This has potentially-important implications for the next stages of this work, which is to attempt to extrapolate the valuation results from our split samples to the poulation at large.

Since warm glow is found to be statistically significant in all specifications, it is interesting to interpret model predictions of the "true" compensating variations for changes in the amenity once the value derived from giving itself is netted out. Table 4 presents estimates for each model of the magnitude of warm glow and the "true" compensating variations, followed by the mean stated willingness to pay on the survey. Most of the stated willingness to pay by individuals appears to be warm glow rather than value of amenity increments. In the joint model, mean warm glow is \$27, with a low of \$10 and a high of \$62, and the mean compensating variations are \$4 and \$7 for 50% and 100% increases in whale populations. The model overpredicts the mean stated willingness to pay bid (which is warm glow plus compensating variation) by \$4-5; this may be due to the fact that the stochastic term in compensating variation was zeroed out in making these predictions.

The separate preferences model also predicts that most of the bid is warm glow, with marginal amenity values of $6 and $10 for users and $2 and $3 for nonusers. This model has greater error in predicting mean total bid. The estimate is nearly $20 too high for users due to the very high estimated warm glow parameter, and about $10 too high for the potential users. This discrepancy in predicting total bid is a subject for further work.

Implications

The results at this stage are suggestive rather than definitive, but it is encouraging to see that an AIDS-based demand and valuation model appears to fit the data on whalewatching and valuing whale population increases well. This may be due to the fact that with respect to both functional form and stochastic structure, the model is internally consistent. Particularly noteworthy are the highly significant warm glow in the CVM responses, and the highly significant nonuse motivation in both demand and valuation. These results suggest that it is possible to "fine-tune" or discipline CVM responses with related market behavior, in order to separate out what might be called "signal" in the CVM response (the true valuation of increments in an environmental amenity) from the "noise" (the warm glow, or satisfaction from giving that is unrelated to the specific amenity being valued). The ability to separate the true valuation from warm glow in valuation exercises should help defuse arguments that the CVM exercise is totally meaningless, while accomodating what appears to be a very legitimate point about multiple motivations embodied in peoples' responses to CVM questions.

As noted at the outset, this is a summary of work in progress, so it is incomplete in a number of respects. Future directions include the development and estimation of a participation model that follows from the AIDS demand share and valuation model, and extrapolation of valuation estimates from the model to the population at large. While the framework is capable of predicting the probability of being a nonuser, a potential user, or a user as a function of key population parameters such as distance from the recreation site, this has not yet been attempted. While censoring appeared to be a relatively minor phenomenon on willingness to pay responses, a more complete model would account for both sources of censoring. An additional issue which arises is flexibility of the demand system. While the AIDS model is capable of approximating to first order any unknown demand function, it imposes the assumption that elasticities have the same sign for all in the estimation sample. Related work suggests that when elasticities are estimated via Fourier series approximations, following Gallant's (1981, 1984) work, some in the sample have positive quality and income elasticities and others have negative elasticities (Larson and Loomis 1993b). A logical direction for allowing this flexibility within the AIDS model is the globally flexible AIDS model developed by Chalfant. Finally, a more general model than the present one would use information from all whalewatchers, including those who took incidental or multiple purpose trips as well as primary-purpose trip-takers.

Footnotes

1. Eventually (but beyond the scope of this paper), it should be possible to assess how the proportions of users, potential users, and nonusers change across the population, especially with regard to such factors such as distance from the coast, environmental avidity, information, and income. This issue is very important in estimating total values of whale population increases for society as a whole.

2. This is clearly the case for charter boat trips, which are of a predetermined duration. While it is possible to "choose" the number of hours to watch whales on a shore-based viewing trip, there is some question about whether variations in individuals' reported time spent whalewatching is due more to differences in hourly onsite costs or simply to measurement error.

3. When the use-related term α_z is held at zero, the only change in the expenditure function when z changes comes from the nonuse parameter ϕ. With u>0, ϕ must be non-positive for $\partial c(p,z,u)/\partial z \leq 0$, i.e., for an increase in whale population not to decrease the non-use value derived from whales.

References

Andreoni, J. 1989. "Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence." *Journal of Political Economy* 97 (Dec.): 1447-1458.

Bishop, R.C., and T. A. Heberlein, "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" *American Journal of Agricultural Economics* 61(1979): 926-930.

Boyle, K. J., and R. C. Bishop, "Welfare Measurements Using Contingent Valuation: A Comparison of Techniques." *American Journal of Agricultural Economics* 70(1988): 20-28.

Bockstael, N. E., I. E. Strand, and W. M. Hanemann. "Time and the Recreation Demand Model." *American Journal of Agricultural Economics* 69 (May 1987): 293-302.

Cameron, T. A. "Combining Contingent Valuation and Travel Cost Data for the Valuation of Nonmarket Goods." *Land Economics* 68 (August 1992): 302-317.

Chalfant, J. A. "A Globally Flexible, Almost Ideal Demand System." *Journal of Business and Economic Statistics* 5 (April 1987): 233-242.

Deaton, A., and J. Muellbauer. "An Almost Ideal Demand System." *American Economic Review* 70 (1980): 312-326.

Dillman, D. A. *Mail and Telephone Surveys—The Total Design Method.* New York: Wiley, 1978.

Gallant, A. R. "On the Bias in Flexible Functional Forms and An Essentially Unbiased Form: The Fourier Flexible Form." *Journal of Econometrics* 15 (1981): 211-245.

Gallant, A. R. "The Fourier Flexible Form." *American Journal of Agricultural Economics* 66 (May 1984): 204-208.

Green, R. D., and J. M. Alston. "Elasiticities in AIDS Models: A Clarification and Extension." *American Journal of Agricultural Economics* 73 (May 1991):.

Hausman, J. A. "Exact Consumer's Surplus and Deadweight Loss." *American Economic Review* 71(1981): 662-676.

Kahneman, D. "Comments to the CVM Panel." Washington, D.C., August 1992.

Kahneman, D., and J. L. Knetsch. 1992. "Valuing Public Goods: The Purchase of Moral Satisfaction." *Journal of Environmental Economics and Management* 22 (January): 57-70.

Krutilla, J. V. 1967. "Conservation Reconsidered." *American Economic Review* 57:777-786.

LaFrance, J. T., and W. M. Hanemann. "The Dual Structure of Incomplete Demand Systems." *American Journal of Agricultural Economics* 71(1989): 262-274.

Larson, D. M. "Separability and the Shadow Value of Leisure Time." *American Journal of Agricultural Economics* 71(August 1993): forthcoming.

Larson, D. M. "Testing Consistency of Direct and Indirect Methods for Valuing Nonmarket Goods." Working paper, University of California, Davis, 1990, presented at the 1989 AERE meetings.

Larson, D. M., and J. B. Loomis. 1993a. "Separating Warm Glows From Marginal Values of Nonmarket Goods." Working paper, University of California, Davis, May 1993.

Larson, D. M., and J. B. Loomis. 1993b. "Towards Measuring Use and Nonuse Values From Related Market Behavior: Some Preliminary Results." Forthcoming in Western Regional Committee W-133, Benefits and Costs in Natural Resource Planning, Sixth Interim Report, ed. J. Bergstrom. Athens, GA: University of Georgia.

Loomis, J. B. "An Economic Evaluation of the Public Trust Resources of Mono Lake," Institute of Ecology Report No. 30, University of California, Davis, 1987.

Mitchell, R.C., and R.T Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, DC: Resources for the Future, 1989.

Sellar, C., J. R. Stoll, and J.-P. Chavas, "Validation of Empirical Measures of Welfare Change: A Comparison of Nonmarket Techniques." *Land Economics* 61(1985): 156-175.

Smith, V. K., W.H. Desvousges, and A. Fisher, "A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits," *American Journal of Agricultural Economics* 68(1986):280-290.

White, K. J. "A General Computer Program for Econometric Methods – SHAZAM." *Econometrica*, January 1978, pp 239-240.

Table 1. Descriptive Statistics for Users and Potential Users

Variable	Units	Mean	Std. Dev.	Min.	Max.
Total Sample for Estimation-- 593 observations					
Budget Share (w)		0.003	0.004	0.00	0.05
Full Price (p)	$/trip	158.2	102.	7.37	729.
Full Income (y)	$/year	65766.	22661.	23240	149280
Exp. Sightings (z)	# whales	6.546	7.66	1.00	50.0
Avidity (Imp)		2.962	0.62	0.75	3.75
Age	years	41.27	13.0	11.0	89.0
Gender (G)	m=1, f=2	1.502	0.50	1.00	2.00
Education (Ed)	years	15.86	2.51	6.00	21.0
No. of Earners	#/hh	1.608	0.69	1.00	6.00
Miles (Mls)		94.47	190.	1.00	2369.
Willingness to Pay:					
50% Increase (wp_1)	$/year	26.01	35.8	0.00	500.
100% Increase (wp_2)	$/year	29.78	39.1	0.00	500.
Users-- 335 Observations					
Budget Share (w)		0.005	0.005	0.0004	0.05
Full Price (p)	$/trip	154.	105.2	7.37	729.
Full Income (y)	$/year	66037.	22397.	30600.	149280
Exp. Sightings (z)	# whales	8.08	8.75	1.00	50.0
Avidity (Imp)		3.10	0.55	0.75	3.75
Age	years	40.0	11.4	17.0	72.0
Gender (G)	m=1, f=2	1.55	0.49	1.00	2.00
Education (Ed)	years	16.1	2.37	8.00	21.0
No. of Earners	#/hh	1.62	0.67	1.00	5.00
Willingness to Pay:					
50% Increase	$/year	27.57	42.9	0.00	500.
100% Increase	$/year	32.20	46.8	0.00	500.
Potential Users--258 Observations					
Budget Share (w)		0.00	0.00	0.00	0.000
Full Price (p)	$/trip	163.	98.1	19.6	542.
Full Income (y)	$/year	65414.	23038.	23240.	137310
Exp. Sightings (z)	# whales	4.54	5.33	1.00	50.0
Avidity (Imp)		2.78	0.66	0.75	3.75
Age (A)	years	42.9	14.7	11.0	89.0
Gender (G)	m=1, f=2	1.43	0.49	1.00	2.00
Education (Ed)	years	15.4	2.64	6.00	20.0
No. of Earners	#/hh	1.59	0.71	1.00	6.00
Miles (Mls)		99.2	63.3	1.00	313.
Willingness to Pay:					
50% Increase		23.99	23.54	1.00	120.
100% Increase		26.65	25.82	0.00	150.

Table 2. Estimation Results for the Participation Equation

Variable	Coefficient (Asymp. t)
log(y)	0.55793 (1.71)
log(z)	0.17559 (2.18)
log(Imp)	1.0241 (2.83)
G	0.28639 (1.55)
log(Age)	-0.36517 (-1.19)
log(Mls)	-0.25983 (-3.59)
Intercept	-6.6389 (-2.04)
Log-L:	-162.22
Restricted Log-L	-208.31
χ^2 statistic:	92.2
Critical $\chi^2_{.95,\ 6\ \text{d.f.}}$	12.6
Maddala R^2	0.11
McFadden R^2	0.22

Model Predictions:

Predicted		Actual 0	Actual 1
	0	698.	57.
	1	2.	2.

Pct. Correct Predictions: 0.92

Table 3. Nonlinear Systems Estimates of Joint Behavior-Willingness to Pay Model

	Separate Preferences Model		Joint Model
Parameter	Users	Potential Users	Users and Potential Users
Intercept (α_1)	0.02238		0.02470
	(2.21)[a]		(3.12)
Own Price (γ_{11})	0.00222		0.00225
	(4.60)		(5.89)
Income (β_1)	-0.00250		-0.00277
	(-2.46)		(-3.45)
Quality (α_z)	0.65338E-04	0.20135E-03	0.12147E-03
	(0.87)	(2.67)	(2.66)
Warm Glow (ψ)	-0.61931E-03	-0.50064E-03	-0.41671E-03
	(-4.95)	(-6.29)	(-11.9)
Nonuse (ϕ)	-0.49957E-04	-0.98198E-04	-0.69134E-04
	(-1.93)	(-2.77)	(-3.51)
λ_w	-0.74880E-03		-0.47333E-03
	(-1.06)		(-0.87)
λ_1	1.1724	-2.5211	-0.51466
	(1.09)	(-1.52)	(-1.80)
λ_2	0.58367	-1.2625	-0.43324
	(0.80)	(-1.23)	(-2.43)
Log-Likelihood	-424.8	-960.4	−230.8
ρ_{w1}	-.259	---	-.235
ρ_{w2}	-.257	---	-.238
ρ_{12}	.967	.925	.952

[a]Asymptotic Student's-t statistics in parentheses.

Table 4. A Comparison of Warm Glow and "True" Compensating Variations With Stated Willingness to Pay for Whale Population Increases

Variable	Mean	Std.Dev.	Min.	Max.
Joint Model--593 Observations				
Warm Glow	27.40	9.44	9.68	62.19
Compensating Variation for:				
50% Increase	4.02	1.77	-0.63	15.56
100% Increase	6.88	3.02	-1.08	26.59
Stated Willingness to Pay for:				
50% Increase	26.01	35.8	0.00	500.
100% Increase	29.78	39.1	0.00	500.
Users Only Model-- 335 Observations				
Warm Glow	40.88	13.86	18.95	92.42
Compensating Variation for:				
50% Increase	6.017	1.928	2.737	12.57
100% Increase	10.28	3.296	4.679	21.49
Stated Willingness to Pay for:				
50% Increase	27.57	42.9	0.00	500.
100% Increase	32.20	46.8	0.00	500.
Nonusers Only Model--258 Observations				
Warm Glow	32.741	11.531	11.63	68.72
Compensating Variation for:				
50% Increase	1.6115	2.5137	-6.75	7.994
100% Increase	2.7541	4.2973	-11.5	13.66
Stated Willingness to Pay for:				
50% Increase	23.99	23.54	0.00	120.
100% Increase	26.65	25.82	0.00	150.