Topics in Nonmarket Valuation
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1 Introduction

Non-market goods are goods that carry no price and cannot be purchased. Examples are public bads or public goods that are endowed upon society such as a national park. In these cases, although the aggregate quantity of the good or bad supplied may be observed, the individual or aggregate expenditures or valuations of the good will not. Usually all that can be observed is how consumption of private goods changes with the level of the nonmarket good. To assess a value to these type of goods is a great challenge to demand theory.

In a series of five lectures Hanemann has given an overview of the nonmarket valuation research as has been developed in the last decades with a strong emphasis on environmental goods. The outline of this report follows the structure of these lectures–every lecture is summarized in one section.

First a short introduction in conventional demand theory is provided followed by a historical outline of the development of nonmarket valuation in the United States and an outline of the remaining part of this report.

1.1 Theory of Consumer Demand

Consider an individual with an income Y, facing a set of n goods from which $\mathbf{q}$ goods are consumed by this individual. Assume the individual possesses a quasi-concave utility function, $u(\mathbf{q})$. Consumers are faced with a set of prices $\mathbf{p}$ and choose a bundle of goods by maximizing utility, subject to their budget constraint. The solution to that problem $\mathbf{q}^*$ is a set of ordinary demand functions, giving quantity demanded as a function of price

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and income. Demand is uncompensated because as prices change, income is not adjusted to compensate for the resulting change in utility.

Substituting $\mathbf{q}^*$ back into u yields the indirect utility function $v(\mathbf{p}, Y)$, which defines the highest level of utility attainable, given prices $\mathbf{p}$ and income Y. Roy's identity relates v and x: The derivative of the indirect utility with respect to the ith price yields the ith demand function, after normalizing by the marginal utility of income.

Dual to maximization of utility subject to a maximum expenditure, is expenditure minimization subject to attainment of minimum utility. The solution to this minimization problem, $\mathbf{q}^* = h(\mathbf{p}, U)$, is a set of compensated or Hicksian, demand functions, which give the quantity demanded as a function of price and utility. Income is of no consequence; as prices change expenditures are adjusted to maintain constant utility.

Substituting h back into the minimization problem yields an optimal value function, $e(\mathbf{p}, U) = \mathbf{p}'h(\mathbf{p}, u)$, the expenditure function, which is concave in $\mathbf{p}$. The expenditure function, e, and compensated demand, h, are related according to Shepard's lemma which states that demand for the ith commodity is simply the derivative of the expenditure function with respect to the ith price. Because of the concavity of e the Hessian (the matrix of second derivatives) is symmetric and negative semidefinite. Furthermore, concavity of e implies that all compensated demand function are downward sloping, or at least do not slope upward.

Two types of demand functions have been derived: Marshallian (ordinary) and Hicksian (compensated). Marshallian functions are usually estimated, yet it is Hicksian function that need to be used to compute measures of welfare (see below). Ordinary demand functions have the disadvantage that price and income effects are bundled together; therefore, the effect of a price change as reflected by an ordinary demand function will involve price and income effects. Compensated demand function focus on prices alone.

However, Willig derived conditions on income elasticities and expenditure shares that imply a close agreement between both measures and Hausman showed how to compute the compensated demand function directly from the ordinary demand function. Thus no approximation was necessary. Unfortunately, these computations are rather difficult.

The typical situation with conventional goods is that the researcher observes a time series or cross section of consumption and prices of the good, and from those data, estimates demand. The indirect approach that is necessary for measureing the demand for nonmarket goods presents unique challenges to consumer theory.

Because not all quantities can be converted to prices, the utility function induces restrictions on the demand and expenditure functions. If the set of restricted compensated demand functions are estimated (or derived from estimated ordinary demand functions), under certain circumstances the restricted expenditure function can be recovered and then differentiated with respect to the non-market good, q_n, to obtain its compensated demand function. Unfortunately, when integrating back to the expenditure function, the constant of integration will remain unknown. If that constant involves q_n then it will not be possible to fully recover the demand function for this good. However, if there exist a weak complementary good of q_n, that means that when demand for good i drops to zero, not only good n is not demanded but marginal changes in q_n have no effect on the expenditure function, then it is not necessary to know the expenditure function, just the integral of the Hicksian demand function of the other good suffices.

1.1.1 Welfare Evalution

What something costs does not necessarily reflect what something is worth (known as the Diamond and Water paradox of Smith). Benefit measures should be derived from demand rather than from supply functions. And when formulating the demand function, it is important to distinghuish marginal from non-marginal value. For the latter knowledge about preferences is required. The first attempt to measure welfare in terms of demand was made by Marshall. He measured consumer surplus by calculating the area between the price level and the demand curve, estimating the demand curves by measuring the demand at different price levels. Hicks showed how to derive the indirect utility function from the demand curve. He formulated welfare measures for price and income changes in monetary terms, based on equivalence relations between commodities (with money as the numeraire) and thus measuring value in exchange. The maximum willingness to pay (WTP) equals the amount that should be substracted from the old or new income to stay on the same indifference curve. The minimum willingness to accept (WTA) equals the amount that should be added to the old or new income to stay on the same utility curve.

He introduced the concepts of compensating variation(CV) and equivalent variation(EV), which should satisfy:

$$v(\mathbf{p}^1, Y^1 - \mathrm{CV}) = v(\mathbf{p}^0, Y^0) \equiv u^0 \quad \text{and} \quad v(\mathbf{p}^1, Y^1) = v(\mathbf{p}^0, Y^0 + \mathrm{EV}) \equiv u^1$$

If $u^1 > u^0$ then CV is WTP and EV is WTA. If $u^1 < u^0$ then -CV is WTA and -EV is WTP.

Because only ordinary demand is usually estimated, consumer surplus is frequently used as a benefit measure. However, this usage is inappropriate because price effects are compounded by income effects. Hanemann(1989) showed that for an environmental good for which there is no close substitute, differences between EV and CV may be large due to income effects. The income effects are large, because the individuals have access to a highly valued environmental resource, which increases their effective income significantly.

1.2 History

Environmental valuation grew out of cost-benefit analysis, which itself first emerged as a practical tool of government decision making in the US in the early part of this century. Until 1946 cost-benefit analysis were just a practical tool for managing.

The first report that applied standard welfare analysis to the analysis of federal policy, known as the "Green Book", dealt with the economic analysis of river basin projects. It covered most aspects of project evaluation, including measurement of benefits and costs, correct definition of secondary impacts forcasting future price levels, choice of a discount rate, period of analysis, allowance for risk, treatment of taxes, and cost-allocation for multipurpose projects. But although this report recommended to use adjusted, estimated market values for effects that could not be directly measured in the market, the emphasis was on market prices. Moreover, the academic world did not believe appropriate prices could be found for nonmarket goods such as recreation.

The only exception was Hotelling. He was the only responder that came with a solution when requested to describe a way to measure the value a National Park. He argued that the social value of a good is just the area under its demand curve. To measure the demand curve for a national park he suggested to measure the costs that were associated with visiting the park, such as for travel, equipment or lodging. Because of the variation in these costs among visitors, the demand for different prices could be determined and the demand curve constructed.

However, it would take 10 years before his idea was recognised. In 1958 two studies appeared that applied his method. From then on the travel-cost method developed quickly and became widely used in water resource projects and later also for government activities such as road and rail transportation, education and urban renewal.

In the same year that Hotelling proposed the travel cost method, Wantrup suggested another approach , known as contingent valuation: Ask individuals how much money they are willing to pay to make use of a public good. In the early 1960's the first survey-studies were carried out. From 1965 to 1980 a lot of refinements of both the travel-cost and the CV method were proposed.

Two other important innovations during this period concerned the conceptual foundations of non-market valuation (Hanemann,1992). Natural environment is not a conventional type of economic commodity, and people may value the natural environment–at least in part–out of considerations unrelated to their own immediate and direct use of it. Weisbrod focused on uncertainty and the option value, that people who do not now visit a national park might give to the park because they want to preserve their option of visiting it in the future. Krutilla focused on bequest value and existence or non-use value. People might want to preserve the park for their children or might just obtain satisfaction from mere knowledge that part of the wilderness in North Americal remains.

Since the 1980's a mathematical solution to incorporate uncertainty and non-use value has been provided. A key implication of the consensus definition which has emerged is that non-use value can only be measured by the CV method: it cannot be measured through the travel cost or similar methods that rely on the demand for surrogate market goods because it reflects a value placed on the natural environment from quite separate motives. Therefore, recent studies use both methods simultanuously.

1.3 Empirical methods

There are three basic approaches to obtaining measures of non-market values empirically: models of behavior that derive from demand for services of recreational sites; models of the demand for generic attributes; and contingent or hypothetical valuation approaches that value access or quality changes directly from consumers' responses to questions. The first method includes travel cost models and random utility models. The procedure is as follows: Find a market good that captures people's preferences for the non-market item (e.g. is complementary to the non-market item) one wishes to value and value the existence of that market good. In section 2 the general method and some of its pitfalls will be discussed. Section 3 elaborates on this, introducing discree choices and uncertainty.

Modeling consumer choice for generic characteristics, in contrast to site specific goods, has become standard fare in housing studies, but is rarely used in environmental evaluation studies. The hedonic travel cost model is an attempt to utilize insights from the housing market, where the market insures that the attributes that are valued are priced at the margin. It tries to regress the travel costs individuals incur in visiting a a recreational site on the measures of quality characteristics at the site. The underlying procedure is to find a market good that captures people's preferences for the non-market item and value the effect of a change in the non-market item.

These first two methods are based on revealed preference and often measured as travel costs. They measure only the use value. The third method values the non-market item itself. It is based on contingent valuation and measures the total value; both use and non-use value. Contingent valuation is the subject of section 4. Section 5 evaluates recent empirical studies combining both models, section 6 concludes.

2 The travel cost approach: Single & multiple equation systems

The market good that captures people's preferences for recreation best is travel costs, including entrance fee, cost of travelling to the sites and expenses at the site such as equipment, food and lodging.

Hotelling's recommendation in 1947, although not implemented before 1957 was: (a) to survey visitors at a site (e.g. National park) and find out where they came from and what their costs were; (b) to plot a demand function (number of visits against price) using some measure of cost per mile; and (c) to measure Marshallian consumer surplus. The resulting demand model implies a 2-good utility function $u = u(x_1, z)$, where x_1 is the number of trips to this recreation site and z is a "Hicksian composite commodity" (all other goods). Hicks theorem states: Assume that prices $p_2, ..., p_N$ vary in strict proportion, so that $p_i = \theta \bar{p_i} \quad i = 2...N$ for some fixed vector $\bar{p_2}...\bar{p_N}$ and some positive scalar θ. Then, there exists a neo-classical utility function $\psi(\cdot,\cdot)$ such that $u(x_1, x_2, ..x_N) = \psi(x_1, z)$ where $z \equiv -\sum_{i-2}^{N} \bar{p}_i x_i$ Normalizing $p_z = 1$ to 1 gives $x_1 = g_1(p_1, u^0)$ and, for somebody facing price p_1^0 with cut-off price p_1^*, the value of the site in terms of willingness to pay (WTP) is measured by CV:

$$v(p_i^0, Y - \mathrm{CV}) = v(p_1^*, Y) \quad \text{or} \quad \mathrm{CV} = \int_{p_1^0}^{p_1^*} g_1(p_1, u^0) dp_1$$

This measures the area under the compensated (Hicksian) demand curve for a normal good.

However, this raises the question what to do with substitutes. Omission of the prices of substitutes could bias the estimated coefficient of p_1, depending on the shape of the Hicksian function and on correlation between p_1 and the prices of the substitutes. Only in linear demand model with uncorrelated prices the coefficient of p_1 is unbiased when the prices of substites are omitted. It is possible to include the price of substitutes directly in the Hicksian demand function, however, this would violate Hicksians composite commodity theorem.

If people base their choices on cost minimisation the Hicksian demand function would be simply the original function if this site were the cheapest site and otherwise 0. However, in practice data refute this–people base their choice also on quality. Therefore it is important to estimate the (incomplete) system of demand equations for a group of substitute sites. To model this as a set of linear equations with quality parameters β_i is a somewhat sterile approach. It does not describe site characteristics that differentiate these sites. Moreover, it is not consistent with utility theory, because it violates symmetry and negative semi-definiteness of the Slutsky-terms.

Two ways to introduce site characteristics have been developed. If there are sufficient degrees of freedom, it is possible to regress the $\beta's$ on characteristics of the site. Otherwise site characteristics have to be introduced explicitly into the demand system, along with prices and income.

The focus has been on the demand for sites and not on the demand for an activity (or several activities) aggregated across sites because of the problem with aggregating data of demands for an activity over different sites

In the generalised Lancaster model quality is introduced as a parameter in the utility function. This parameter can be a measure of the availability of public goods, attributes of the x's, like water quality in general, or attributes of the individual, like water quality at a particular site. Each differentiated commodity is a seperate good, with its own bundle of attributes (qualities) and its own price. One selects quality implicitly, through the selection of quantities (which goods are not chosen). The utility function has only to satisfy weak complementarity, that is when quantities are zero, $\partial u/\partial q = 0$.

A change in quality shifts the utility function. From observed demand functions the underlying utility functions should be recovered to measure the welfare implications of quality changes or just by measuring the change in consumer surplus. However, unlike demand estimates where model predictions can be compared with behavior, welfare analysis produces estimates that are never verifiable. (Bockstael, McConnell and Strand). Moreover, the shape of the indirect utility function affects the welfare measure and the measures are often based on extrapolations outside the observed range.

Other problems that arise with the use of this model include how to measure price, how to account for time and how to deal with self-selection on the sample when data are collected on-site. There are not always satisfactory solutions for these problems and one should be aware of them.

Problems with measuring the price variable include how to allocate to any particular trip the costs associated with owning and maintaining durable goods and equipment; and how to allocate joint costs to specific sites during a multi-site trip.

The treatment of travel time as component of costs are difficult to implement. A fraction of the wage rate can be used or time can be included as a separate variable. The estimates will improve when combining these data with survey data about subjects their labor market constraints. However, because of the unknown opportunity costs of traveling time, it is argued that TCM yields only ordinally measurable welfare estimates and cannot be used as the only technique for nonmarket good valuation. (Randall, 1994)

3 Discrete & discrete/continuous choice in travel cost

A major feature of disaggregated choice data such as are used in TCM is the presence of corner solutions: The discrete choice is embodied in the decision on which x_i's are to be zero. The choice to go to a particular site and not to another is a discrete one. The alternatives are usually mutually exclusive. The magnitude of the non-zero x_i's is a continuous choice.

Modeling discrete choices in a utility-theoretic manner start with a purely discrete choice of the goods x_i's. If the consumer's preferences are such that he always selects a positive quantity of every commodity this would constitute a pure continuous choice. This is what is assumed in conventional demand analysis. If this is not the case then there is some form of a corner solution to the utility maximisation function. Hanemann distinguishes between two types of corner solutions. When the different goods are mutually exclusive on logical grounds or when people's preferences are such that the x_i's are perfect substitutes, only one x_i will be chosen. This is called an extreme corner solution. When several or all of the x_i's can be chosen it is called a general corner solution, which is much harder to model. Almost all of the existing literature deals with extreme corner solutions, because this is easier to model.

The modeling of discrete/continuous choices is a longstanding interest of Hanemann's and was the subject of his thesis as well as his subsequent research (e.g. Hanemann 1984, Bockstael, Hanemann and Strand 1986, Hanemann 1998).

Statistical models for use with discrete dependent variables have existed already for a long time. McFadden first showed how to formulate these statistical models so as to make them consistent with an underlying model of economic behavior, based on individual maximization of a random utility or profit function. A purely statistical model of discrete choice permits one to make predictions about people's behaviour. The advantage of deriving the statistical model from an underlying economic model of utility or profit maximizing behavior is that this permits one to make inferences of wider economic significance, for example calculating economic welfare measures such as compensating or equivalent variation for changes in the prices or quality of the items available for choice.

In many instances of microeconomic decision making, the discrete, or qualitative, choices that people face are also linked to a companion continuous, or quantitative, choice. For example in sportfishing; the discrete choice include which sites to visit and what species to target; the continuous choice is the number of fishing trips per season made to each site and/or for each target species.

Hanemann has made a significant contribution to the development of statistical models of discrete/continuous choices consistent with an underlying model of random utility or profit maximization.

However, the current practice in the recreational demand literature is still an ad hoc approach which separates the discrete/continuous choice into a purely discrete choice of which site to visit, typically using a generalized logit model (see for instance Hausman et al. 1995 for an example), combined with an ad hoc model for the determination of the continuous choice of how many visits to make over the season. There are only five papers presenting a utility-theoretic statistical analysis of a discrete/continuous choice involving multiple alternatives. Moreover, these are limited to situations with only three or, four discrete choice alternatives. Whereas in reality the number of alternatives can be much bigger.

Recently Hanemann(1998) has proposed a method to analyse discrete/continuous choices involving a substantial number of alternatives. This approach combines simulation-based numerical integration of multi-dimensional probability integrals together with specially structured formulations of choice sets and random utility functions that exploit patterns of substitution among the alternatives in such a way as to significantly reduce the dimensionality of probability integrals in the likelihood function.

3.1 Random utility models

There is some tendency in conventional demand analysis to focus almost exclusively on the deterministic component. The stochastic component is assumed to arise outside the eocnomic model and tho have no real significance for the economic interpretation of the statistical results. In RUM models, the situation is different. The stochastic component is an essential part of the economic model; it interacts with the deterministic component and materially affects the model's implications for the prediction of behavior and the evaluation of welfare. Therefore, both components need to be taken seriously by the investigator. In a RUM model it is assumed that, while the individual knows her preferences with certainty and does not consider them stochastic, they contain some components which are unobservable to the econometric investigator and are treated by the investigator as random (Hanemann, 1984) These unobservables could be characteristics of the individual and/or attributes of the item; they can stand for both variation in preferences among member of a population and measurement error.

The simplest way to handle errors is to use additive errors. The utility derived from choosing item 'i' is then the 'deterministic' utility gained from total income minus the price of that item and it's quality $\bar{v}_i(y-p_i, q_i)$ plus some error term ϵ_i. The probability that the i^{th} item will be chosen is then equal to the probability that $\bar{v}_i + \epsilon_i \geq \bar{v}_j + \epsilon_j$ for all other goods j. And this is equal to $Pr\{\epsilon_j - \epsilon_i \leq \bar{v}_i - \bar{v}_j \quad j \neq i\}$. When the difference between the error terms have a logistic distribution a logit function for $Pr\{i^{th}$ item chosen$\}$ can be obtained. For the general corner solution one probability inequality for each item that will not be chosen has to be found, similar to the simplifying case with additive error terms.

4 Contingent valuation

Recreational demand models do not measure the non-use value of nonmarket goods. The only way to find out how people value a nonmarket good like for instance a national park where they have never been, is to ask them. Contingent valuation methods use surveys or experiments to elicit preferences; in contrast, revealed preference methods observe actual behavior to infer preferences. CV responses can also be used to measure the use value of non-market goods and can then be compared with results from revealed preferences.

The fourth lecture covered the theory and practice of Contingent Valuation (CV) from an economic as well as an statistical perspective. The economic perspective requires that the survey responses are economically meaningful in the sense that they constitute a utility-maximizing response to the survey question. In recent years, increasing attention has been given to the statistical aspects of contingent valuation (CV) survey design and data analysis.

First, individuals can be asked to tell their own WTP(open ended questions) or can be asked whether they are willing to pay an amount 'x' (closed-ended questions). The latter can be single-bounded and multiple bounded. The single-bounded approach asks respondents to answer "yes" or "no" at one question about their WTP. The double-bounded format, proposed by Hanemann(1985) follows up the initial question with a second question, again involving a specific dollar cost to which they can respond with a "yes" or "no". The additional bid leads to sharper bounds on the estimate of WTP. Open ended CV questions are less incentive-compatible and often too difficult for subjects. Therefore, nowadays closed-ended questions are used mostly. However, this approach creates a heavy demand for statistical technique.

Statistically, the CV responses are discrete dependent variables since they are measured on a nominal or ordinal scale. If the CV responses can take a finite number of values, the probability that it takes a particular value can be expressed as some function dependent on covariates describing the subject, the item being valued or any other pertinent aspect of the survey, and a vector of parameters to be estimated from the data. If the response can only be "yes" or "no" the set of probabilities is just Pr{answer is "Yes"} $= f(\cdot)$ and Pr{answer is "No"} $= 1 - f(\cdot)$.

To satisfy both perspectives, the statistical model should be formulated in such a way that it is consistent with an economic model of utility maximization. It is the RUM concept which provides the link between a these perspectives. In a RUM model it is assumed that, while the individual knows her preferences with certainty and does not consider them stochastic, they contain some components which are unobservable to the econometric investigator and are treated by the investigator as random. (See also section 3.1). If the individual is confronted with the possibility to get a higher quality or quantity for a certain amount C, she will only say "yes" when the C is smaller then her maximum WTP for this change. The respondent knows her own WTP , but the investigator does not and treats it as a random variable.

It is now possible to define a particular corresponding density function(cdf) for the individual's random WTP or to specify a particular indirect utility function and a cdf for ϵ from which the corresponding cdf for the WTP can be constructed. (see Hanemann & Kanninen, 1998 and refs. therein).

Very detailed instruction how to design a good survey and all the decision steps you have to go through is provided on the last day. The initial tasks are to indentify the item to be valued and to identify the target population. The next step is to choose a survey mode (mail, telephone, personal interview). Then the sampling plan and the questionaire have to be developed. After some refinements, pre-tests and pilots the data are collected and, after data coding- and cleansing, analysed. Every step has its own pitfalls and choices should therefore be made very carefully.

5 Data combination & choice experiments

Travel cost and contingent valuation data can be uefully combined in one joint model of preferences. The same set of preferences ought to be driving both travel behavior and survey responses (Cameron, 1992). utility-theoretic framework can be used to blend the two types of information in a single joint model to produce what should be a more comprehensive picture of preferences that would be available from either information source used seperately. Travel cost information is limiting in that it can reveal consumer preferences for nonmarket goods only for current users. Contingent valuation survey methods are only hypothetical but they can shed light on the configuration of preferences outside this domain.

The discrete choice model and the demand equation must be estimated simultanuously in order to impose equality constraints upon the corresponding parameters of the utility function and the associated ordinary demand function. To impose the requirement that two decisions (one real and one hypothetical) reflect the identical underlying utility function, the CVM and TCM models must be estimated simultanuously. With independent errors, it is simple to combine the two specifications by summing the two seperate log-likelyhood functions and constraining the corresponding coefficients to be the same. Another possibility is to use correlated errors. When unobservable factors which affect respondents' answers to the CVM discrete choice question are simultanuously likely to affect their behavior, one can allow for correlation between the error terms in both the demand model and the discrete choice model.

6 Concluding remarks

Hanemann has presented an impressive theoretical framework to handle demand for nonmarket goods. The theory is not restricted to economic behavior with respect to environmental goods, but can be seen as a general extension of utility models in which all types of choices, discrete, continuous or a combination of them, for all types of goods, including public goods, can be modeled. What misses still is a theoretical framework in which bounded rational choices can be incorporated.

Hanemann also referred to prof. Knetch, who had just given a TI workshop in behavioral economics, but had started his career in TCM methods. Hanemann agrees with Knetch that people make different choices when the question is asked differently, but thinks that this is a problem for the survey design and not for the underlying model. I'm not convinced that this will solve the problem. You still have to know what you want to know from people, what makes one survey question preferable to the other? Moreover, although Hanemann thought people would use some local optimisation criterium and not a (fully-rational) global optimisation criterium, he still uses the latter. The models that make use of some local optimisation principle are still very ad hoc.

A second problem with the theoretical approach is the welfare measures, which are based on aggregated utilities. Although the framework is very detailed and generates very detailed data on choice behavior, it is not clear how these individual data should be aggregated. This is a very fundamental problem as it is not even sure whether that is possible at all.

Finally I would like to make some remarks on the applications of this research. I think, one has to be careful with the interpretation of the generated data on environmental valuation. The name suggests a measurement for the value of the environment. This is generally not true. In most studies only the recreational demand is measured. They do not reflect the biological relevance of the environment.

For instance, a statement like, "the recreational losses due to the Exxon Valdez oil spill were 3,8 million dollars," might show the importance of (recreational) fishing in that area and might reflect the population density of Alaska, but the political statement that "these results may provide useful input to government agencies attempting to estimate the appropriate level of taxes, fines or regulations for deterring damage to the environment" (Hausman et al. 1995) is to my opinion not justified and highly arrogant.

Some effects of environmental damage reveal themselves only in the long run. Most respondents are not able to recognize these effects. They might also underestimate the effects on a larger scale and because of this lack of knowledge, not adjusted their willingness to accept. According to Hanemann these problems can be avoided by choosing the right population to interview. If the outcome is dependent on this type of choices from the researcher, how objective are these results then? I would strongly suggest all researchers, especially these who work for the government, to choose only ecologists as their respondents.

Another thing that puzzled me, is the logical consequence from the TCM: recreation in the United States has a higher value than in The Netherlands, as distances are much smaller here. This seems not to be in accordance with the number of members of the dutch environmental organisation "Natuurmonumenten", which is the largest organisation of its kind in the world. It might be that CV methods, which measure also the non-use value would elicit higher values for Dutch recreationists. However, the hypothetical nature should make economists sceptical about the results.

References

Bockstael N., Strand I. and Hanemann W.M., 'Time and the Recreational demand Model,' *AJAE* (69) 1987, 293-202

Bockstael, Nancy E., Kenneth E. McConnell and Ivar Strand, 'Recreation,' Chapter VIII in J. B. Braden and C. D. Kolstad (eds) *Measuring the Demand for Environmental Quality*, North-Holland, 1991

Cameron T. A., 'Combining Contingent Valuation and Travel Cost Data for the Valuation of Nonmarket Goods,' *Land Economics* (68) 1992, 302-17

Hanemann W. M., 'Discrete-Continuous Models of Consumer Demand,' *Econometrica*, 1984a

Hanemann W. M., 'Welfare Evaluations in Contingent Valuation experiments with Discrete Responses' *American Journal of Agricultural Economics*, 66, 1984b, 332-341

Hanemann, W. M., J. Loomis and B. Kanninen, 'Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation,' *AJAE* (1991), 1255-1263.

Hanemann W. M., 'Preface' (The History of Cost-Benefit Analysis), in Stale Navrud (ed) *Pricing the European Environment* Scandinavian University Press, 1992.

Hanemann W. M.,'Modeling Complex Discrete/continous Choices with an Application to environmental Valuation' forthcoming 1998.

Hanemann Michael and Barbara Kanninen, The Statistical Analysis of Discrete-Response CV Data, Working Paper No. 798, Department of Agricultural & Resource Economics, University of California, Berkeley. July 1996; corrected October 1998.

Hausman J. A., H. Leonard & D. McFadden, 'A Utility-consistent, Combined Discrete-Choice and Count Model,' *J. Public Economics*, 56 (1995) 1-30

Kolstad, Charles and Braden, John, 'Environmental Demand Theory,' Chapter II in J. B. Braden and C. D. Kolstad (eds) *Measuring the Demand for Environmental Quality*, North-Holland, 1991

Randall A., 'A Difficulty with the Travel Cost Method,' *Land Economics* (70) 1994, 88-96