5

Measuring the Value of Non-Market Goods and Services

Without the observable price and quantity data that are available when goods or services are traded in the market, economists have devised innovative techniques for measuring changes in value for natural resources and the environment. Three of the techniques, travel cost, random utility and hedonics use information to indirectly determine what a market might reveal in value if it did exist. The contingent value technique attempts to measure the change in value directly.

Some goods and services like recreational fishing and wildlife viewing are not traded in a well functioning, traditional market. That is, they are not supplied by private firms and consumers do not pay market prices. Nonetheless, indviduals benefit from their use and, therefore, the loss of such environmentally related goods signifies welfare losses to these individuals. Conceptually, the same measure of benefit applies to market and non-market goods, that is, the maximum amount an individual would pay to avoid losing, or gaining, access to the good. Since these are non-market benefits, typically, there is no producer, or the consumer is both the producer and consumer. Thus, measures of non-market benefits are concerned with estimates of consumer demand and consumer surplus. There are a variety of methods that have been developed to measure this value concept in the absence of markets.

Non-Market Valuation Techniques

In the absence of ownership and efficient pricing, we need special techniques to place consumer preferences for natural resources and environmental goods and services on common ground with the demands for more conventional commodities. Three types of procedures have been employed to measure these demands.

- **Travel cost and random utility models, which are based on expenditures and travel behavior for recreational opportunities**
- **Hedonic methods of decomposing prices of market goods to extract embedded values for related environmental attributes**
- **Experimental methods for eliciting preferences, either by using hypothetical settings, called contingent valuation, or by constructing a market where none existed**

Travel cost models, random utility models, and hedonic methods are indirect measures based on observable behavior. Experimental methods, or contingent valuation, are based on direct surveys of individuals.

INDIRECT MEASUREMENT TECHNIQUES

Indirect techniques rely on observable behavior to deduce how much something is worth to an individual even though it is not traded in markets. These methods produce value estimates that are conceptually identical to market values, but they must be measured more

creatively since market data are not available. Indirect techniques include travel cost models, random utility models, and the hedonic pricing method.

▸ *Travel Cost Model*

Overview. The travel cost method is, in general, employed to estimate recreational values. This technique assumes that visitors to a particular site incur economic costs, in the form of outlays of time and travel expenses, to visit the site. In effect, these economic expenditures reflect the "price" (albeit implicit) of the goods and services provided by the site, and are an indirectly observable indication of the minimum amount that a visitor is willing to pay to use the site (with all its associated attributes).

By observing the characteristics of individuals visiting the site — for example, the specific attributes of their trip to and from the site as well as the total number of visits — economists are able to estimate the "derived demand" for the site. That is, for any given or implicit price, the derived demand relationship will determine the number of visits consumers will "purchase" at that site.

The travel method technique has a number of applications — it can be used, for example, to measure the effects on a consumer's willingness-to-pay because of changes in access costs to a recreational area, or the elimination of a site, or changes in environmental quality.

Issues that Require Attention in Travel Cost Modeling

- **Costs, because time costs are often critical in recreational consumption**
- **Characterizing the quality dimensions of the site and taking proper account of substitute sites and their characteristics**
- **Estimating both the individual's decision as to whether to use the site and his or her decision as to how much to use it**

Advantages of This Technique. The travel cost technique is relatively uncontroversial because it mimics empirical techniques used elsewhere in economics. Economists generally tend to prefer techniques of this sort because they are based on actual behavior rather than verbal responses to hypothetical scenarios. In the travel cost model, individuals are actually observed spending money and time, and their economic values are deduced from their behavior. In appropriate circumstances, this model can often be applied without enormous expense.

Disadvantages of This Technique. The greatest disadvantage of travel cost and other indirect techniques is that they can not be employed unless there is some easily observable behavior that can be used to reveal values. Thus, in the case of measurement of nonuse values these methods are inappropriate. In the case of nonuse values, there is no observable interaction between the individual and the resource in question

Travel cost models are also technically and statistically complicated. Understanding the conceptual measure requires understanding the connection between consumer surplus (measures of changes behind demand curves) and the "maximum willingness to pay" concept. In addition, data must be employed to statistically estimate increasingly sophisticated econometric models that take into account such factors as sample selection problems and non-linear consumer surplus estimates. Finally, the resulting estimates sometimes have been found to be rather sensitive to arbitrary choices of the functional form of the estimating equation and the treatment of time. Though much technical work has been dedicated to improving these methods, they will continue to be subject to the problems that plague all empirical economic estimation.

Data Needs. While the early travel cost models used information on the proportions of visitors from increasingly distant zones of origin from which their travel occurred (called "zonal models"), current methodology requires data on individual travelers. Typically this information is collected through surveys. On-site surveys can provide heavy sampling of users, but these need to be augmented with surveys of the general population in order to learn what proportion of the population uses the resource. A survey of the general population also provides data on the characteristics of the resource users as well as information that helps the economist estimate the participation decision.

Unfortunately, a travel cost study is best at assessing the current situation. To analyze the gains or losses from changes in the recreational resource, economists need to conduct travel cost studies under varying circumstances or they need a way of extrapolating the effects of change. Ideally, an important recreational resource could be subject to periodic travel cost studies, so that the effect of differing conditions of the resource could better be estimated. This is especially true if one is measuring the damages from a disaster such as the effects of an oil spill on recreational boating. Economists would find invaluable a travel cost study that had been completed before the disaster.

Estimating the Value of Recreational Bird-watching: Travel Cost Model

Suppose a development project calls for filling a wetlands area, an area that is a major bird-watching site for the region. In this case the valuation question might be: What would be a money measure of the lost value of observing birds in this area due to the development? The answer could be used as input to a benefit-cost analysis of the proposed development.

The first step in such an analysis is to survey participants on bird-watching trips about trip expenses. The second step would examine the relationship between the number of participants and trip expenses such as in the table.

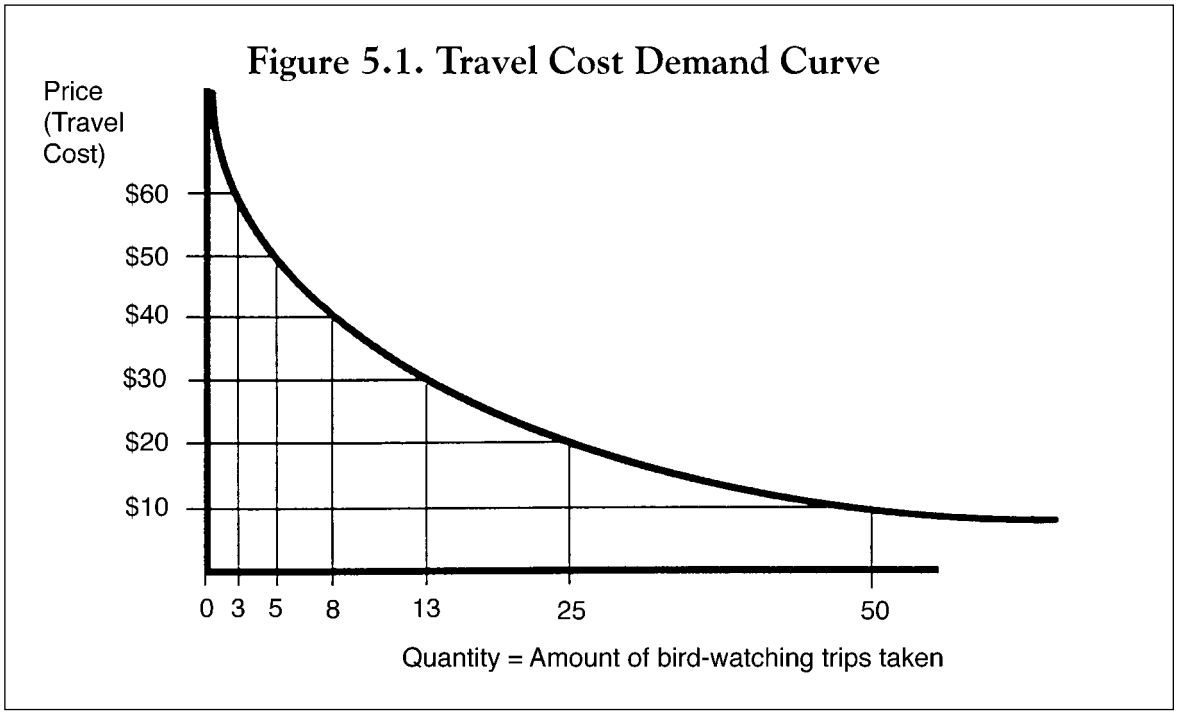
Table 5.1. Travel Cost Data.

Trip Expense Range	Number of Trips
< $10	50
$10-$19	25
$20-$29	13
$30-$39	8
$40-$49	5
$50-$59	3

In the absence of such ideal studies, researchers would find any information on the level of use of the resource beneficial (e.g., historical information on number of users, their location of residence, and frequency of use). Moreover, any information that would help shape the sampling method would be valuable (e.g., when the resource is most heavily used and by whom).

As with all environmental valuation, the researcher's most difficult job is connecting the environmental event with the effect on the user. Any insights here are invaluable. In the development case, the analysis would need to be accomplished as a hypothetical case. To use results from a travel cost model, researchers need to know how recreationists would be affected by the development activity and how that effect would translate into changes in behavior.

From this and other data collected about the individual participants, we can estimate a travel cost demand curve with the travel cost as the price and the number of trips as the quantity shown in Figure 5.1. This demand curve will also be a function of other information collected from the individuals that help to explain their bird-watching behavior (e.g., income, ethnicity, education, etc.). We must also make adjustments econometrically



for the non-participants, the people who might go bird-watching in the area under different circumstances (e.g., if they had lower travel costs).

The travel cost demand curve applies to a representative individual from a particular geographic region or socio-economic class. It is not the aggregate demand curve. To get an aggregate value measure, individual consumer surplus must be augmented by a population expansion factor which this individual represents.

This curve represents the recreational demand for bird-watching prior to the development. If bird-watching is completely eliminated at this site, then the total consumer surplus is lost. However, the more likely consequence is that the quality of the bird-watching trip will be lowered. We will need to predict how the demand curve will shift, and then measure the consumer surplus with and without the shift.

▸ *Random Utility Models*

Overview. Though conceptually similar to travel cost models, random utility models do not focus on the number of trips recreationists make to a given site in a season; rather, they focus on the choices of recreationists among alternative recreational sites. This type of model is particularly appropriate when substitutes are available to the individual so that the economist is measuring the value of the quality characteristics of one or more site alternatives.

Advantages of This Technique. The same advantages that apply to travel cost models are applicable with random utility models. Many economists consider this method as the state-of-the-art in recreational demand modeling. Relative to the travel cost model, this approach deals well with substitute sites and environmental quality considerations.

Disadvantages of This Technique. The approach has all the disadvantages of the travel cost method, though it is much more data intensive.

Data Needs. Because a researcher needs to know what alternative sites are considered by recreationists, as well as recreational behavior with respect to all these alternative sites, the data requirements are greater. In addition, accurate measurements of the characteristics of alternative sites are important.

Estimating the Value of Recreational Bird-Watching: Random Utility Model

The superiority of the random utility model approach over the standard travel cost method will be evident. In a hypothetical example (Table 5.2), suppose Site I is the birdwatching area proposed for development. However, there are two other relevant sites in that area, each having its own characteristics with regard to the experience the bird-watcher will have. These experiences are represented in the example by a species diversity index and a

Table 5.2. Multiple Sites with Quality Differences.

Site Attributes	Site I Proposed Fill Site	Site II	Site III
Species Diversity Index	5.2	4.8	3.6
Bird-Spotting Index	8.7	5.9	6.3

bird-spotting index. The greater the diversity of species and the more likely the individual will see unusual birds, the greater the value of the recreational experience. Because of locational differences and the value of time, each individual will incur different costs to go to each site. Table 5.3 summarizes the pattern of visits to the different sites by three different individuals. The data in these two tables are the type typically used to determine the value of access to the site, or changes in quality at a site. These data provide us with observable information about how individuals make tradeoffs between the quality of the site and the cost of accessing it. In the travel cost model, we only have one site, so it is difficult to determine how individuals respond to quality changes unless the quality of that site has changed over time.

Note that the random utility model requires data about participation at the study site as well as relevant alternative sites. Site characteristics are also implicitly considered in the decision model. In the example, we looked at a species diversity index and an index of number of bird spottings per hour as the relevant characteristics that vary across sites.

Table 5.3. Trip Expenditures and Number of Trips Taken (Example of data from three individuals in our sample).

	Individual	Site I	Site II	Site III
1	Travel Costs	$10	$20	$30
	Number of Trips	4	2	0
2	Travel Costs	$15	$8	$40
	Number of Trips	0	5	1
3	Travel Costs	$20	$20	$20
	Number of Trips	5	2	3

▸ *Hedonic Pricing Methods*

Overview. The hedonic pricing method is another technique to determine environmental value. In its earliest applications, these techniques were intended to capture the willingness-to-pay measures associated with variations in property values that result from the presence or absence of specific environmental attributes, for instance, air pollution, noise, or water views. By comparing the market value of two properties which differ only with respect to a specific environmental attribute, economists may assess the implicit price of that amenity (or its cost when undesirable) by observing the behavior of buyers and sellers.

A variation on the approach of comparing the effects of an environmental attribute would involve comparing the price of a single piece of property over successive sales. By correcting for other factors that might influence the value of the subject property, economists are able to isolate the implicit price of some amenity or bundle of amenities which have changed over time. The price of a house may be affected by factors such as the number of bedrooms, the square footage, the existence of a pool, the proximity to local schools, shopping, highways. The price may also be affected by the proximity to, or quality of, environmental amenities. Air quality has been found to be a determinant of housing prices in Los Angeles; whether or not a property abuts a woodland may also matter. Hedonic methods can also be used to estimate the effect of certain disamenities on the price of a house, for instance, the impact on the price of a residential property adjacent to an area affected by a spill or some proposed unfavorable development.

The process for estimating an hedonic price function that relates housing prices to the quantities of various characteristics is reasonably straightforward. However, it is much more difficult to derive value measures from these estimated functions. Only under very restrictive assumptions can values be obtained directly from these estimated functions. In most cases, a two-stage procedure that depends on information from multiple markets is necessary.

Advantages of This Technique. The hedonic techniques, like travel cost and random utility models, depend on observable data resulting from the actual behavior of individuals. Market data on property sales and characteristics are available through real estate services and municipal sources and can be readily linked with other secondary data sources.

Disadvantages of This Technique. Most environmental incidents will have only small, if any, effects on housing prices. Even where effects do exist, it may be difficult to estimate them using econometric methods because many factors, many of which are correlated, influence housing prices. For example, a house located near a factory with emissions that reduce air quality may be in a poorer section of town where schools are not as good and there are few other amenities like parks. Even when implicit prices for environmental amenities can be estimated, it is usually very difficult to obtain measures of value from these models. The connection between the implicit prices and value measures is technically very complex and sometimes empirically unobtainable.

Data Needs. Data needs include prices and characteristics of houses sold in the housing market of interest. In particular, a measure or index of the environmental amenity of interest is needed.

DIRECT TECHNIQUES

▸ *Contingent Valuation Method (CVM)*

Overview. The most obvious way to measure nonmarket values is through directly questioning individuals on their willingness-to-pay for a good or service. Called the contingent valuation method, it is a survey or questionnaire-based approach to the valuation of non-market goods and services. The dollar values obtained for the good or service are said to be contingent upon the nature of the constructed (hypothetical or simulated) market and the good or service described in the survey scenario.

The contingent valuation technique has great flexibility, allowing valuation of a wider variety of non-market goods and services than is possible with any of the indirect techniques. It is, in fact, the only method currently available for estimating nonuse values. In natural resources, contingent valuation studies generally derive values through the elicitation of respondents' willingness-to-pay to prevent injuries to natural resources or to restore injured natural resources. Since the first published contingent valuation study on valuing outdoor recreation appeared in 1963, more than 1,400 related documented papers, reports, and books have been published.

In contingent valuation methods, randomly selected samples or stratified samples of individuals selected from the general population

are given information about a particular problem. They are then presented with a hypothetical occurrence such as a disaster and a policy action that ensures against a disaster; they are then asked how much they would be willing to pay — for instance, in extra utility taxes, income taxes, or access fees — either to avoid a negative occurrence or bring about a positive one. The actual format may take the form of a direct question ("how much?") or it may be a bidding procedure (a

A Sampler of Contingent Valuation Questions

- **Would you approve of the wetlands protection program if it reduced your income by some dollar amount ($5-1500, posted price varied on questionnaires) per year in order to have your bag or catch preserved at current levels (or 50% or 25%), rather than have your bag or catch reduced to zero because of continued marsh loss? (Circle one letter.)**

  a. Yes **b. No**

  Source: Bergstrom, J.C. et al. 1990. Economic Value of Wetlands-Based Recreation. *Ecological Economics* (2):129-147.

- **Suppose that the Terrebonne wetlands were to disappear tomorrow and that persons like yourself had a chance to save this particular area. What would you reasonably estimate to be the maximum you would be willing to pay each year in order to guarantee the use of this area for you and your household?**

$0-$15 __	$45-60 __	$90-100 __	$200-250 __
$15-30 __	$60-75 __	$100-150 __	More than $250 __
$30-45 __	$75-90 __	$150-200 __	

  Source: Farber, S. 1988. The Value of Coastal Wetlands for Recreation: An Application of Travel Cost and Contingent Valuation Methodologies. *Journal of Environmental Management* (26):299-312.

- **What amount on the payment card, or any amount in between, is the most you (your household) would be willing to pay in taxes and higher prices each year to continue to keep the nation's freshwater bodies from falling below the boatable level where they are now? In other words, what is the highest amount you (your household) would be willing to pay for Goal C each year before you would feel you are spending more than it's really worth to you (all members of your household)? (Note: Payment card is income dependent and shows average household public expenditures on various public programs such as roads, education and defense.)**

  Source: Mitchell, R.C. and R.T. Carson. 1989. *Using Surveys to Value Public Goods*. Baltimore. Johns Hopkins University for Resources for the Future.

ranking of alternatives) or a referenda (yes/no) vote. Economists generally prefer the referenda method of eliciting values since it is one most people are familiar with. The resulting data are then analyzed statistically and extrapolated to the population that the sample represents.

Contingent valuation studies are conducted as face-to-face interviews, telephone interviews, or mail surveys. The face-to-face is the most expensive survey administration format but is generally considered the best, especially if visual material needs to be presented. Non-response bias is always a concern in all sampling frames. In other words, people who do not respond have, on average, different values than people who do respond.

Pros and Cons of Contingent Valuation

Pros

1. **Based in economic utility theory and can produce reliable estimates.**
2. **Most biases can be eliminated by careful survey design and implementation.**
3. **Currently the only method available to measure important nonuse values associated with natural resources.**
4. **Has been used successfully in a variety of situations.**
5. **Is being constantly improved to make the methodology more reliable.**

Cons

1. **Estimates of nonuse values are difficult to validate externally.**
2. **Stated intentions of willingness to pay may exceed true feelings.**
3. **Results may appear inconsistent with tenets of rational choice**
4. **Respondents may be unfamiliar with the good or service being valued and not have an adequate basis for articulating their true value**
5. **Respondents may express a value for the satisfaction ("warm glow") of giving rather than the value of the goods or service in question**
6. **Respondents may fail to take questions seriously because the financial implications of their responses are not binding.**

Advantages of This Technique. In principle, contingent valuation methods can be used to estimate the economic value of anything, even if there is no observable behavior available to deduce values through other means. It is the only method that has any hope of measuring "existence values," i.e., the value that individuals place on simply knowing the natural resource exists in an improved state. This is because since existence values are not connected with use and all other methods depend on observing actual behavior associated with the resource.

Though the technique requires competent survey analysts to achieve defensible estimates, it is not difficult to understand. The responses must be statistically analyzed, but require no more than the understanding of a mean or median value.

Disadvantages of This Technique. When conducted to the exacting standards of the profession, contingent valuation methods can be very expensive because of the extensive pre-testing and survey work. In addition, while this technique appears easy, its application is fraught with problems, for example, the possibility of strategic bias by respondents or structural problems in questionnaire design. Moreover, question framing, mode of administration, payment formats, and interviewer interactions can all affect results.

Many questions have been raised about the reliability of the contingent valuation method for the calculation of nonuse values particularly in regard to natural resource damage assessment under OPA. Because this subject is complex and contentious and has ramifications not applicable to the use of CVM in applications other than damage assessment, it is not discussed here.

Data Needs. The quality of a contingent valuation questionnaire depends upon the amount of information that is known beforehand about the way people think about the resource in question. Information on who uses the resource and who knows about it are critical. When the contingent valuation method is applied to use values, the economist undertaking the survey will want to sample populations most likely to use the resource. The key point is that while all the information necessary for assessing an individual's value of the resource is collected in the survey, the economist needs help in identifying a representative sample and information to allow extrapolation to the population.

Illustration of Contingent Valuation Methodology

Suppose development along the coast of New Jersey would result in impacts to coastal waters that will lower the quality of recreational activities. It is estimated that such development might lower recreational fish catches by (100, 50, 25%), increase beach closings, and lessen the quality of the recreational boating experience. A number of environmental groups have proposed a program that will mitigate impacts of the development on recreation. It is to be funded by a tax on individuals such as yourself and would be ($5-1,500) per year. Given that the development will occur, and specifically relating to fishery catch, are you willing to fund the mitigation program at this cost to you? (A "yes" answer requires respondent to specify the amount of his/her willingness-to-pay for mitigation to prevent various levels of catch reduction.)

a. yes
b. no

Table 5.4. Willingness-to-Pay for Mitigation.

	Percent Responding Yes to Reduction in Catch		
Individual's cost for mitigation	100% Reduction	50% Reduction	25% Reduction
$5-25	100%	100%	95%
$25-50	88%	78%	65%
$50-75	51%	45%	40%
$75-100	22%	15%	12%
$100-200	8%	6%	4%
$200-300	7%	7%	6%
$300-400	5%	2%	1%
$400-500	2%	1%	1%
$500-750	1%	1%	1%
$ 750-1000	0%	0%	0%
>$1000-1500	0%	0%	0%

This data can be used to econometrically determine the mean willingness-to-pay for the mitigation program (mean=$160). The aggregate measure would be determined by multiplying the mean willingness-to-pay by the appropriate sample size. In this case, we might only be interested in fishers, beach goers, or boaters (n=10,000): Willingness-to-pay = $160 x 10,000 = $1,600,000 per year.