ENVIRONMENTAL ECONOMICS

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TRAVEL COST METHOD

One of the oldest approaches to environmental valuation

Proposed in a letter from **Harold Hotelling** to the US Forest Service in the 1930's, first used by **Wood and Trice in 1958**, popularized by **Clawsen and Knetsch** (1966)

Premises

- People bear cost to visit regions or sites (national park or estate)
- Hypothesis : These costs are at least equal to the minimum value of the benefit people get when visiting the sites and their environmental goods or services. Thus these travel costs can be used as a proxy for the price of visiting outdoor recreational sites . (In other words, the recreational benefits at a specific site can be derived from the demand functions that relate observed user's behaviour to the cost of visit.)

TRAVEL COST METHOD

Steps of analysis

- Estimate the cost of travel and visit for each regions of origin

- Questionnaire : visitors trip, expenses and characteristics

- Estimate of the demand for the site (and environmental goods and services) depending on the cost of travel and visit and other characteristics

TRAVEL COST METHOD

Options for Applying the Travel Cost Method

1. A simple zonal travel cost approach, using mostly secondary data, with some simple data collected from visitors. The zonal travel cost method is applied by collecting information on the number of visits to the site from different distances.

2. An individual travel cost approach, using a more detailed survey of visitors. The individual travel cost approach is similar to the zonal approach, but uses survey data from individual visitors in the statistical analysis, rather than data from each zone. This method thus requires more data collection and slightly more complicated analysis, but will give more precise results.

TRAVEL COST METHOD

3. Hedonic Travel Cost Model which attempts to place values on the characteristics of recreational resources.

4. A random utility approach using survey and other data, and more complicated statistical techniques. The random utility approach assumes that individuals will pick the site that they prefer, out of all possible sites. Individuals make tradeoffs between site quality and the price of travel to the site. Hence, this model requires information on all possible sites that a visitor might select, their quality characteristics, and the travel costs to each site.

TRAVEL COST METHOD

The travel cost method is applied by collecting information on the number of visits to the site from different distances. Because the travel and time costs will increase with distance, this information allows the researcher to calculate the number of visits purchased at different prices: the demand function and the consumer surplus or economic benefits, for the recreational services of the site.

Step 1: The first step is to define a set of zones surrounding the site. These may be defined by concentric circles around the site, or by geographic divisions that make sense, such as metropolitan areas or counties surrounding the site at different distances.

TRAVEL COST METHOD

Step 2: The second step is to collect information on the number of visitors from each zone, and the number of visits made in the last year.

Step 3: The third step is to calculate the visitation rates per 1000 population in each zone. This is simply the total visits per year from the zone, divided by the zone's population in thousands.

Step 4: The fourth step is to calculate the average round-trip travel distance and travel time to the site for each zone, using average cost per mile (km) and per hour of travel time. What is the opportunity cost of time?

TRAVEL COST METHOD

Step 5: The fifth step is to estimate, using regression analysis, the equation that relates visits per capita to travel costs and other important variables.

From this, the researcher can estimate the demand function for the average visitor. In this simple model, the analysis might include demographic variables, such as age, income, gender, and education levels, using the average values for each zone

TRAVEL COST METHOD

Step 6: The sixth step is to construct the demand function for visits to the site, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming there is no entry fee for the site)

Step 7: The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve.

TRAVEL COST METHOD

Simple Travel Cost Model:

If the price (p) is the only sacrifice made by a consumer, the demand function for a good with no substitutes is $x=f(p)$, given income and preferences.

However, the consumer often incurs other costs (c), such as travel expenses and loss of time. In this case, the demand function is expressed as $x = f(p, c)$.

Under these conditions, the utility maximising consumer's behaviour should be reformulated in order to take such costs into account.

TRAVEL COST METHOD

Simple Travel Cost Model:

Given two goods or services (x_1, x_2), their prices (p_1, p_2), the access costs (c_1, c_2) and income (R), the utility maximizing choice of the consumer is:

$$Max_U = u(x_1,x_2)$$

$$Subject\ to: (p_1 + c_1)\, x_1 + (p_2 + c_2)x_2 = R \qquad (1)$$

Now, let 'x_1' denote the aggregate of priced goods and services, x_2 the number of annual visits to a recreational site, and assume for the sake of simplicity that the cost of access to the market goods is negligible '(c_1=0)' and that the recreational site is free (p_2=0).

TRAVEL COST METHOD

Under these assumptions, equation [1] can be written as:

$$Max_U = u(x_1, x_2))$$

$$Subject\ to:\ p_1x_1 + c_2x_2 = R \qquad (2)$$

Under these conditions, the utility maximizing behaviour of the consumer depends on:

a) His preferences [$u(x_1, x_2)$],

b) His budget (R),

c) The prices of the private goods and services (p_1) and

d) The access cost to the recreational site (c_2).

TRAVEL COST METHOD

The TCM is based on the assumption that changes in the costs of access to the recreational site (c_2) have the same effect as a change in price: the number of visits to a site decreases as the cost per visit increases.

Under this assumption, the demand function for visits to the recreational site is $x_2=f(c_2)$ and can be estimated using the number of annual visits as long as it is possible to observe different costs per visit and up to the cost at which visits become equal to zero.

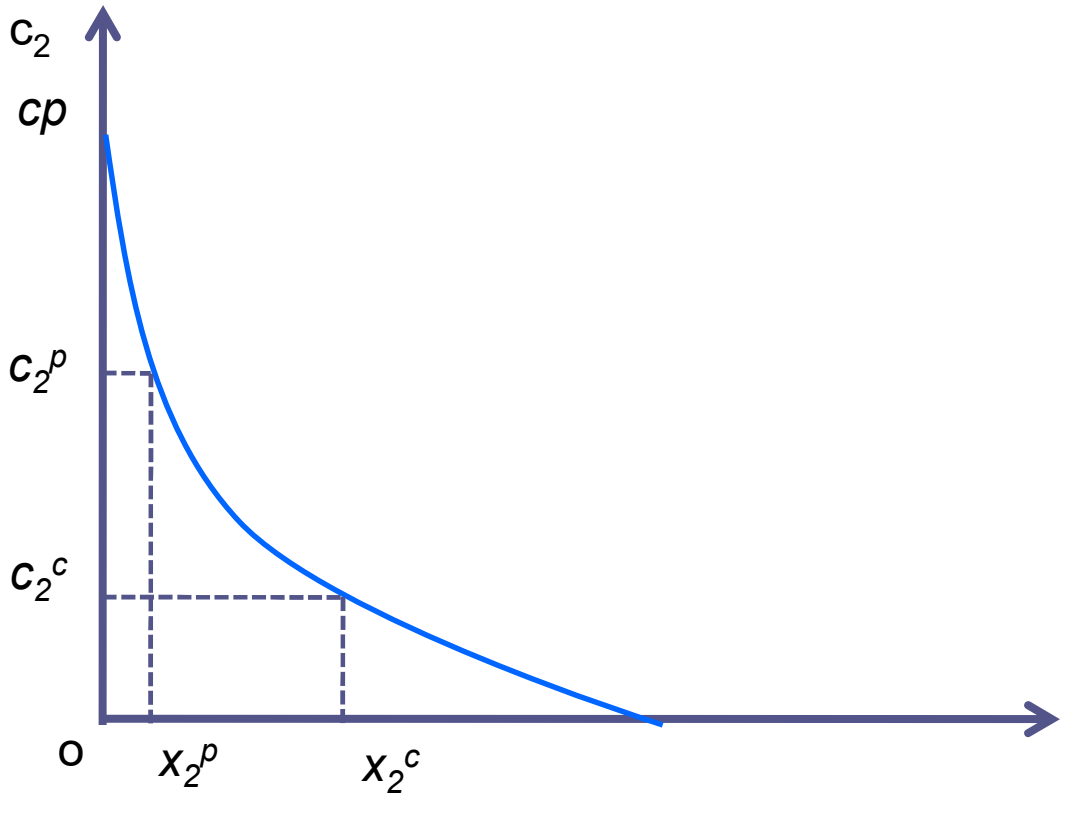
This simple model can be extended to include the effect of other substitute sites.

Alternatively, same model can be used to estimate visits per time be an individual to site with c and p becoming specific to the individual only.

TRAVEL COST METHOD

The basic TCM model is completed by the weak complementarity assumption, which states that trips are a non-decreasing function of the quality of the site, and that the individual forgoes trips to the recreational site when the quality is the lowest possible

TRAVEL COST METHOD



The Figure depicts the expected relationship between the number of visits and cost per visit, given other variables, showing that the number of visits decreases as the cost per visit increases.

TRAVEL COST METHOD

Hedonic Travel Cost Model:

- On many occasion, we are interested in the value of changing characteristics of a site rather than in the value of the site in toto.
- In this respect, hedonic travel cost model attempts to place values on the characteristics of recreational resources.
- Hedonic travel cost model was first proposed by Brown and Mendelsohn (1984) and was later applied to forest characteristics by Englin and Mendelsohn (1991) and coastal water quality by Bockstael et. al. (1987)

Hedonic Travel Cost Model:

Steps:

1. Respondents to a number of sites (e.g. forest) are sampled to determine their zone of origin.

   The levels of physical characteristics are recorded for each site

   A travel cost function is estimated for each zone, as

$$C(Z) = c_0 + c_1z_1 + c_2z_2 + \cdots\ c_mz_m \qquad (1)$$

   Where, C(Z) are travel costs, $z_1 \ . \ . \ . \ z_m$ *are characteristics and* $c_0 \ . \ . \ c_m$ *are coefficients to be estimated.*

TRAVEL COST METHOD

Hedonic Travel Cost Model:

Steps:

A separate regression is performed for each zone of origin such that each will have a vector of coefficients {c0⋯ cm}. For a given characteristics *m,* the utility maximising individual will choose visits such that the marginal costs of characteristics (the coefficient c_m) is just equal to the marginal benefit to him.

TRAVEL COST METHOD

Hedonic Travel Cost Model:

Steps:

2. Estimate a demand curve for each characteristics regressing a site characteristic levels (dependent variable) against the predicted marginal cost of that characteristic and socioeconomic variables for each zone of origin.

A separate regression is run for each characteristics.

The expectation is that the coefficient on the marginal cost variable will be negative implying that as the level of a characteristics rises people are unwilling to pay as much for each further increment.

Issues and Limitations of the TRAVEL COST METHOD

- The travel cost method assumes that people perceive and respond to changes in travel costs the same way that they would respond to changes in admission price.
- Defining and measuring the opportunity cost of time, or the value of time spent on traveling, can be problematic. Because the time spent on traveling could have been used in other ways, it has an "opportunity cost." This should be added to the travel cost, or the value of the site will be underestimated. However, there is no strong consensus on the appropriate measure: the person's wage rate, or some fraction of the wage rate and the value chosen can have a large effect on benefit estimates.

Issues and Limitations of the TRAVEL COST METHOD

- If people enjoy the travel itself, then travel time becomes a benefit, not a cost, and the value of the site will be overestimated. The availability of substitute sites will affect values.
- The most simple models assume that individuals take a trip for a single purpose: to visit a specific recreational site.
- Interviewing visitors on site can introduce sampling biases to the analysis.

Issues and Limitations of the TRAVEL COST METHOD

- Measuring recreational quality, and relating recreational quality to environmental quality can be difficult.
- Standard travel cost approaches provide information about current conditions, but not about gains or losses from anticipated changes in resource conditions.
- In order to estimate the demand function, there needs to be enough difference between distances travelled to affect travel costs and for differences in travel costs to affect the number of trips made. Thus, it is not well suited for sites near major population centers where many visitations may be from "origin zones" that are quite close to one another.

TRAVEL COST METHOD

- The travel cost method is limited in its scope of application because it requires user participation. It cannot be used to assign values to on-site environmental features and functions that users of the site do not find valuable.
- Most importantly, it cannot be used to measure non-use values. Thus, sites that have unique qualities that are valued by non-users will be undervalued.
- As in all statistical methods, certain statistical problems can affect the results. These include choice of the functional form used to estimate the demand curve, choice of the estimating method, and choice of variables included in the model.

CONTINGENT VALUATION METHOD

- Contingent Valuation Method (CVM) was first used by Davis (1963) in a study of hunters in Maine and it was widely developed with Bohm (1972), Randal et.al. (1974), Brookshire et. al., (1976) etc.
- The essence of CVM method involves asking individual to imagine some situation that is typically outside the individual's experience and speculate on how he or she would act in such a situation.
- It is called 'contingent valuation' because the valuation is contingent on the hypothetical scenario put to respondents.

CONTINGENT VALUATION METHOD

- CVM exercise can be split in to five stages:
  - Setting up the hypothetical market
  - Obtaining bids
  - Estimating mean WTP and or WTAC
  - Estimating bid curves
  - Aggregating the data

CONTINGENT VALUATION METHOD

As Carson (1991) noted, there are six main component of a successful CV study:

1. Define Market Scenario
2. Choose elicitation method
3. Design market administration
4. Design sampling
5. Design of experiment
6. Estimate willingness-to-pay function

CONTINGENT VALUATION METHOD

1. **Define Market Scenario:**

Is the information to be conveyed to a respondent? (i.e. one who will be asked about willingness to pay)

To place the respondent in the right time frame of mind to give meaning response to questions

Description of the market should be realistic to the respondent and

Defining appropriate payment mechanism

CONTINGENT VALUATION METHOD

2. Choosing Elicitation Method:

Having properly defined the market scenario, the next step is to decide how best to obtain the valuation process.

There are four ways of eliciting value: direct question, bidding game, payment card and referendum choice.

2.1 Under direct questioning the main task is to ask the respondents about their willingness to pay for the good. However, this suffers from a great demerit in the sense that there are few real markets in which we ask the respondent to generate data and in most occasion people may not spend much effort in determining their willingness to pay which may result in extreme response (either zeroes and very large numbers)

CONTINGENT VALUATION METHOD

2.2 Bidding Game:

Bidding game approach was first used by Randal et.al (1974).

This approach involves a WTP number and seeks a yes-no response.

If the respondent replies yes, the amount is gradually increased until a no response is received. Similarly, if the respondent replies no, the amount is gradually decreased until a yes is received. The main problem with this approach is the starting-point bias.

CONTINGENT VALUATION METHOD

2.3 Payment Card: A card with a number of figures, spanning the range of responses that might be expected. Each card has payment amounts along with several reference expenditure amount.

The basic problem with the payment card is that they can not be used for telephone surveys.

2.4 Referendum or discrete choice:

Under this approach a willingness to pay figure is offered to the respondent who is asked if he or she would be willing to pay that amount, 'yes' or 'no'.

This approach although has the merit of minimizing possible bias and is also familiar to the people in that people often vote yes/no on public referenda. One problem with referenda is that more data are needed to obtain statistically significant results which raised cost of the survey.

CONTINGENT VALUATION METHOD

3. Design Market Administration:

Three approaches to survey administration: mail, telephone and in-person

Mail Survey: cheaper to administer but suffers from the problem of acute non-response

Telephone Survey: relatively inexpensive to administer but limited by the availability of telephone within the population being surveyed.

In-person Survey: Most expensive to administer but can be more reliable. However it suffers from the problem of interviewer bias.

CONTINGENT VALUATION METHOD

4. Sample Design:

It involves two steps: First, select the group (relevant for the study) from which to draw the sample.
Second, draw the random sample.

5. Experimental Design:

Experimental design requires careful design of survey instrument, its administration and its ultimate statistical analysis.

CONTINGENT VALUATION METHOD

6. Estimation of Willingness to Pay Function:

The last step of the Contingent Valuation Method is to take the survey results and correctly estimate the WTP functions.

Problems with the Contingent Valuation Methods:

Despite significant application of CV technique in eliciting values of environmental goods, the method has been scrutinized and found to suffer from a large number of limitations. Following are the important limitations of this method:

Valuation of Environmental Goods

The value elicited in CV surveys are not based on real resource decisions - they are hypothetical.

Presence of ambiguity in what people are valuing

Problem of embedding. This problem generally pertains to the inconsistencies that people face when they are to value an environmental good (e.g. park) versus a group of environmental goods (several parks in our case) when they are substitutes.

Another related problem is the valuation of existence value.