

# **Contingent Valuation Method**

## **A Concept Note**

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## **1. What is Contingent Valuation Method?**

Some aspects of the environmental resources like scenic view of mountains and beaches, wilderness experience in national parks, basic life support functions associated with ecosystem health and biodiversity etc. give utility to human-beings but do not have market values as they are not directly bought and sold in the markets. To use a beach, we may be paying a user fee/entry fee, but this may not be the equivalent to the utility provided by that asset. Similarly some of us may not be using the environmental resource now, but would like to have the option to use it in the future/ or we would like particular species like Asiatic Lion or Giant Panda to be preserved though we do not use it now because we value its mere existence. In all these cases, the use of price-based models may not be appropriate. For a marketed good, the demand and supply for the good at equilibrium determine the market price, which acts as an invisible hand to allocate the resources efficiently. Other important characteristic of these marketed goods are the existence of private property rights and divisibility of factors of production. Because most of the environmental goods do not have property rights, and even if we assign, we cannot exactly know the demand for the good, the only way to know about the people's preference is to ask them through some hypothetical surveys.

One such technique for the valuation of non-market resources and in fact the commonly used technique for valuing the non-use values/passive values of the environment is the Contingent Valuation Method (CVM). This is a survey based method, where people are asked directly how much money they would be willing to pay (or willing to accept) to maintain the existence of (or be compensated for the loss of) some environmental feature such as biodiversity. This technique is called 'contingent' valuation method because people are asked to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental service. The contingent valuation method is also referred to as a 'stated preference' method, because it asks people to directly state their values, rather than inferring values from actual choices. The fact that CV is based on asking what people say they would do (stated) as opposed to what people are observed to do (revealed) is the source of its greatest strength as well as its greatest weakness.

## 2. Applications of the Method

The theoretical method was first proposed by Ciriacy-Wantrup in 1947<sup>1</sup> as a method for eliciting market valuation of a non-market good. In the paper on the economics of soil conservation published in 1947, he mentions “*Individuals may be asked how much money they are willing to pay for successive additional quantities of a collective extra-market good. The choices offered relate to quantities consumed by all members of a social group. ...If every individual of the whole social group is interrogated, all individual values (not quantities) are aggregated. The results correspond to a market-demand schedule*”. The method was practically applied in 1963 by Davis (Davis, 1963)<sup>2</sup> to estimate the value hunters and tourists placed on a particular wilderness area. The method gained popularity after the use of method in quantifying the damages following the Exxon Valdez oil spill in Prince William Sound in USA in 1989. Using this approach, a lower bound estimate of US \$ 2.8 billion was reported to prevent another spill similar to the Valdez with a mean estimate of \$7.2 billion. Given the huge magnitude of numbers generated by the survey, there was controversy over the use of this technique for policy making. Hence in 1993 National Oceanic and Atmospheric Administration commissioned a Blue Ribbon Panel consisting of Kenneth Arrow and Robert Solow (Arrow et al., 1993) and other economists to answer the question ‘Is CV a valid method for determining the lost economic value from natural resource damages?’ The report concluded that the CV method can produce reliable estimates provided the surveys are carefully designed and controlled due to inherent difficulties in eliciting accurate economic values through survey methods. They also gave some recommendations about how the CVM survey should be designed.

The application of CVM has increased since then and several papers exist on CVM. Contingent Valuation Method has been used to estimate the benefits from increasing air and water quality; reducing risk from drinking water and groundwater contaminants; outdoor recreation; protecting wetlands, wilderness areas, endangered species, and cultural heritage sites; improvements in public education and public utility reliability; reduction of food and transportation risks and

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<sup>1</sup> Ciriacy-Wantrup, S.V. (1947). “Capital returns from soil-conservation practices”. *Journal of Farm Economics* 29, 1181–1196.

<sup>2</sup> Davis, R.K. (1963a). *The value of outdoor recreation: an economic study of the Maine woods*. Dissertation, Harvard University.

health care queues; and provision of basic environmental services such as drinking water and garbage pickup in developing countries (Carson, 2000)<sup>3</sup>. In the next section, application of the method is briefly discussed.

### 3. How to carry out a Contingent Valuation Survey?

To elicit Willingness to Pay (WTP)/ Willingness to Accept (WTA) using the CVM, the general approach (as discussed in Hanley, 1990)<sup>4</sup> indicates:

1. Description of the scenario and the impacts of the change in the provision of an environmental good/service are explained (e.g. who will pay for the good, who will use the good etc.).
2. The respondents are invited to consider the proposed context within which the choice concerning the environmental good/service will be made; and
3. the respondents are invited to supply their statements concerning their Willingness to pay (WTP) for a proposed welfare gain/Willingness to Accept (WTA) in compensation for a welfare loss, from which the value attached to a change in the provision of the good/service in question is inferred. Various elicitation methods can be used to get their WTP/WTA. One should also ask them how they would like to pay or accept (e.g. higher taxes, entrance fee, donation to charitable trust etc.) Responses can be elicited either through on-site (face to face; users only), house to house (face to face; users and non-users) or by mail/telephone (remote; users and non-users). The major elicitation techniques used in the literature are:

*a) Open ended*; "how much are you willing to pay?". This approach produces a continuous bid variable and may therefore be analyzed using least squares approaches (OLS).

*b) Take-it-or-leave it (dichotomous choice)*- This method was developed by Bishop and Heberlein (1979)<sup>5</sup>. The respondent is asked "are you willing to pay Rs. X?". This is a closed

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<sup>3</sup> Richard Carson (2000), Contingent Valuation – A user's guide, Environ. Sci. Technol. **2000**, 34, 1413-1418

<sup>4</sup> Hanley, N.D. (1990). "Valuation of Environmental Effects: Final Report - Stage One". Industry Department of Scotland and the Scottish Development Agency, Edinburgh quoted in Evaluation of the environment" The contingent valuation method, by I J Bateman and R. K. Turner, CSERGE working paper GEC 92-18.

ended format, where a Yes or No is expected for the questions. The amount X is systematically stepped across the sample to test individuals' responses to different bid levels. This approach produces a discrete bid variable and requires logit-type analysis.

**c) Double bound dichotomous choice** (with an iterative second round (double-bound) question) (see Hanneman et al., 1991)<sup>6</sup>. For example if the respondent answers yes to the Rs. X bid then they are asked if they are WTP say Rs. 2X (or Rs. 1/2X or 1/3X if they answered no to the initial question)

**c) Modified dichotomous choice method** – Stevens et al (1991)<sup>7</sup> used this procedure. Here the respondent was given a specified amount of money randomly and asked if they would be willing to pay. They were also given an opportunity to bid an amount less or greater than the specified amount of money. Responses, therefore, could be viewed as originating from either an open-ended or a closed-ended dichotomous choice-bidding format. Unlike the discrete choice follow-up approach, this method can be used in mail surveys.

**d) Payment card method** - Payment card technique was developed by Mitchell and Carson (1981)<sup>8</sup> in order to avoid the starting point problem that can arise in traditional bidding applications. Payment cards display a range of rupee values starting from zero and increasing at fixed intervals. The respondent is asked to choose his WTP/WTA from these values. Sometimes the payment values are varied for different income groups and the respondent is asked to choose how much he would be WTP/WTA depending on his income schedule. This is called as anchored payment card. One can use either open ended or closed ended questions.

**e) Iterative Bidding games** – This process is similar to auctions. In the first step the respondent is asked how much he is willing to pay. The stated amount is changed iteratively until the highest amount the respondent is willing to pay/willing to accept is identified.

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<sup>5</sup> Bishop, R.C., Heberlein, T.A. (1980). “Simulated markets, hypothetical markets, and travel cost analysis: alternative methods of estimating outdoor recreation demand”. Staff Paper Series No. 187. Department of Agricultural Economics, University of Wisconsin, Madison, WI.

<sup>6</sup> Hannemann, W.M., Loomis, J. and Kanninen, B. 1991. Statistical efficiency of double bounded dichotomous choice contingent valuation, *Amer. J. Agr. Econ.*, November, 1255-1263.

<sup>7</sup> Stevens, T. H., Echeverria, J., Glass, R. J., Hager, T., and More, T. A. (1991) Existence value of wildlife. *Land Econ.*, 67, No. 4, 390-400.

<sup>8</sup> Mitchell, R. C., and Carson R. T. (1981) “An Experiment in Determining Willingness to Pay for National Water Quality Improvements,” draft report to the US Environmental Protection Agency, Washington DC.

#### 4. Analyze the results

i) Calculate the mean WTP (or WTA) from responses - This commonly involves the omission of protest votes, and/or the use of trimmed means. In case of dichotomous choice method, mean is obtained by calculating the expected value of the dependent variable (WTP or WTA).

ii) Estimation of the bid curve to investigate the determinants of WTP bids – The WTP/WTA is regressed on variables that affect the WTP/WTA for e.g., visits ( $Q_{ij}$ ), income ( $Y_i$ ), social factors such as education ( $S_i$ ), and other explanatory variables ( $X_i$ ). A parameter of the environmental quality of the site ( $E_j$ ) may also be included.

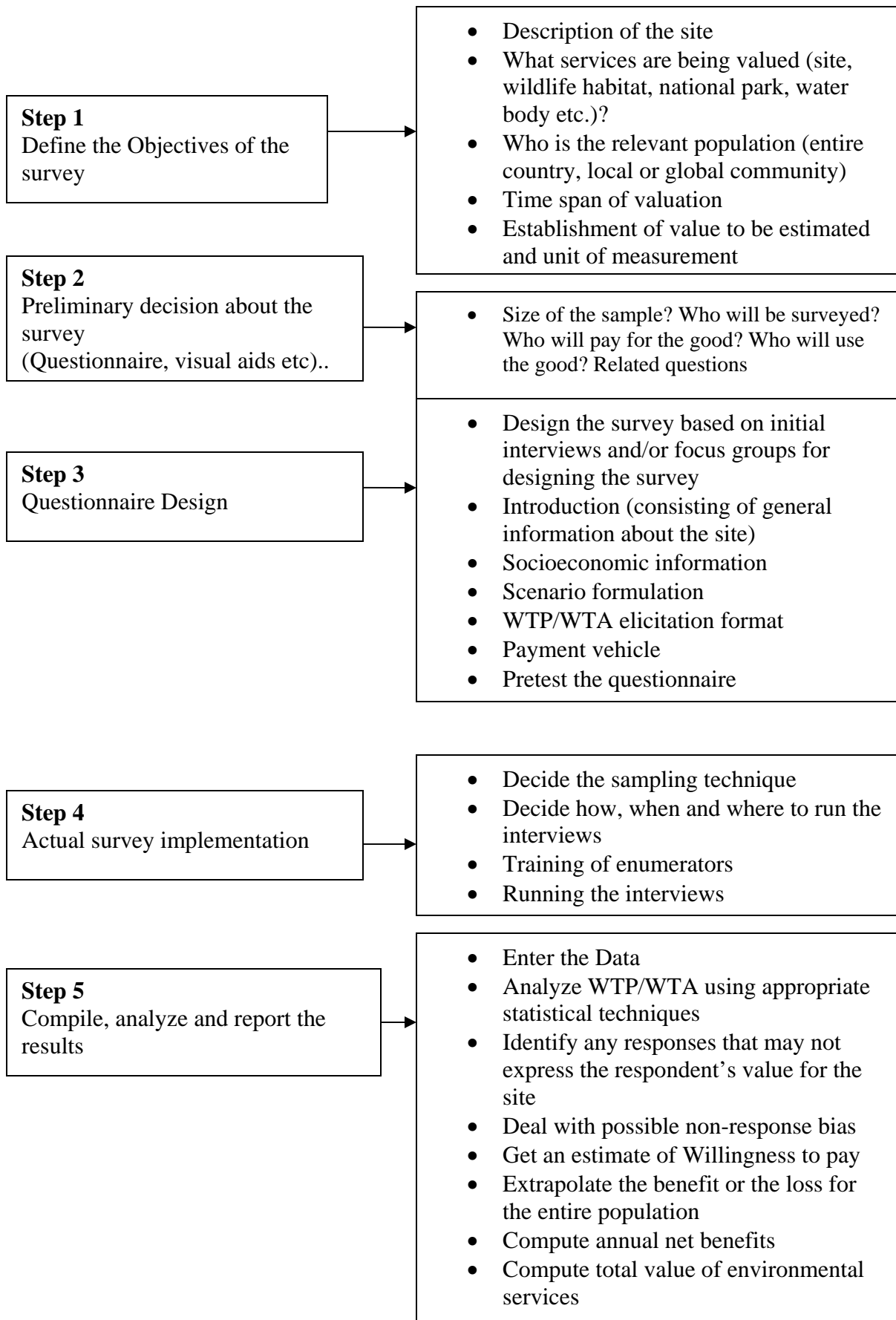
$$WTP_i = f(Q_{ij}, Y_i, S_i, X_i, E_j)$$

The function can be estimated using suitable econometric techniques. There is theoretically no correct form to estimate this function. However, if a log-log function, the coefficients would give elasticities directly. The elasticities tell us how by much the mean WTP/WTA would change for a given change in  $E_j$  (environmental variable under consideration). If a dichotomous payment format has been used then a logit approach is required, relating the probability of a yes answer to each suggested sum to the explanatory variables listed above. For a continuous question format OLS estimation techniques are often employed.

#### **iii) Aggregation**

Once the mean WTP is obtained, the values should be aggregated to get the total WTP for the entire population. This entails decisions about, for example, moving between household and individual data, and distinguishing the relevant population.

See Figure 1 for general approach to conducting the CVM survey.



**Figure 1: General Approach for Conducting a CVM Survey**

#### **4. Possible Biases in Contingent Valuation Method**

Though CVM is a good method, it suffers from various biases (systematic over or under statement of true WTP/WTA). Possible source of bias in CVM method include the following:

- 1) Starting point bias – This usually occurs in bidding games because the value selected has an appreciable impact on the final bid. A way to overcome this is the payment card technique but this induces a different kind of bias called anchoring bias because of the range of values presented on the payment card. Dichotomous choice questions are free from anchoring bias. But they also suffer from the bias that the bid presented to the respondent may be reflecting the respondent's true WTP.
- 2) Vehicle bias – This occurs if the WTP/WTA varies depending on the mode of payment. For example, if the respondent is asked how much they would be willing to pay in the form of a price increase vis-à-vis other modes of payment like tax, user fee etc., and the response may be different. This difference in WTP dependent on the method of payment is called vehicle bias.
- 3) Information bias - Respondents also may change their values depending on the amount of information they are given about a given commodity or situation. For example, if a respondent is provided information about the mean cost of providing the good, the respondent may be WTP differently than they would if they were not informed about the average cost of providing the good. This phenomenon is termed as information bias.
- 4) Hypothetical market bias – The bias occurs due to the hypothetical nature of the markets. Because the market and payment is anyway hypothetical, the individuals declared intentions may not be meaningful at all. This can be minimized by making the hypothetical market as actual and believable as possible, motivating the respondents well and changing the elicitation methods.
- 5) Strategic bias or Free riding bias – If respondents believe that bids will be actually be collected, they may understate their WTP. This bias also occurs if an individual feels that the good would be provided anyway if others contribute, there may be an incentive to free-ride. If the respondent is keen that the good would be provided, there may be an incentive to over-state his WTP, thereby ensuring the provision of the good. This is termed as strategic bias or free riding bias.

- 6) Mental account bias (Part-Whole Bias) – Mental account bias is possible because individuals' WTP responses fail to distinguish between the specific good which is under analysis (the 'part') and the wider group of goods (the 'whole') into which that specific good falls (Kahneman and Knetsch, 1992)<sup>9</sup>. Because of this “when respondents are asked to value some environmental good they may in fact make that valuation on the basis of a much wider range of environmental goods” (Willis and Garrod, 1991)<sup>10</sup>. As a result they may pledge more than their entire income.
- 7) Interviewer and Respondent Bias – It is possible that the interviewer or the very nature in which interview has been carried out can influence the respondent thereby introducing some bias. For example, the interviewer can convince the respondent that a particular environmental good is strongly desirable thereby influencing the respondent to understate his WTP. Sometimes even respondents want to impress upon the interviewer, or they want to prove that they care for environment etc. they may also overstate their WTP.

#### **5) Appraisal - Was the CVM successful?**

Given the nature of biases that CVM could potentially produce, we need to know whether the CVM has been successfully carried out or not. To answer the question we need to consider the technical acceptability of the evaluation estimates produced by CVM. The Blue ribbon Panel (Arrow et al., 1993) gave some suggestions on how to carry a good CVM study.

#### **Suggestions by the Blue Ribbon Panel for a good CVM study<sup>11</sup>**

The Blue Ribbon Panel concluded that CVM studies, if founded adhering to the following guidelines, could lead to estimates that would be reliable enough to be a starting point for a determination of natural resources damages, whether by the judiciary or by administrators.

1. For a single dichotomous question (yes-no type) format, a total sample size of at least 1000 respondents is required. Clustering and stratification issues should be accounted for and

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<sup>9</sup> Kahneman, D., Knetsch, J.L. (1992). “Valuing public goods: the purchase of moral satisfaction”. *Journal of Environmental Economics and Management* 22, 57–70.

<sup>10</sup> Garrod, G. and Willis, K.G. (1991). "The hedonic price method and the valuation of countryside characteristics", *Countryside Change Unit Working Paper 14*, University of Newcastle Upon Tyne.

<sup>11</sup> Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R., Schuman, H. (1993). “Report of the NOAA panel on contingent valuation”. *Federal Register* 58, 4601–4614.

random sub sampling will be required to obtain a bid curve and to test for interviewer and wording biases

2. High non-response rates would render the survey unreliable
3. Face-to-face interviewing is likely to yield the most reliable results
4. Full reporting of data and questionnaires is required for good practice
5. Pilot surveying and pre-testing are essential elements in any CVM study
6. Underestimation of WTP/WTA is to be preferred to overestimation of WTP/WTA.
7. WTP format is preferred
8. The valuation question should be posed as a vote on a referendum, that is, a dichotomous choice question related to the payment of a particular level of taxation
9. Accurate information of the valuation situation must be presented to the respondents, particular care is required over the use of photographs.
10. Respondents must be reminded of the status of any undamaged possible substitute commodities
11. Time-dependent measurement noise should be reduced by averaging across independently drawn samples taken at different points in time
12. A no-answer should be explicitly allowed in addition to the 'yes' and 'no' vote options on the main valuation question
13. Yes and no responses should be followed up by the open-ended question that is, income, distance to the site, prior knowledge of the site and so on.
14. Respondents must be reminded of alternative expenditure possibilities, especially when 'warm-glow' effects can be prevalent (that is, purchase of moral satisfaction through the act of charitable giving).

However, it should be emphasized that in practice this is only one of the criteria upon which both CVM and all other evaluation methods are likely to be judged. Other than that the CVM should also pass the following tests

- a. Price sensitivity test – The higher the cost, lower the demand. In case of binary discrete choice format, this can be tested by observing whether the percentage favouring the project falls as the cost of the project increases. Many good CVM studies pass this test.

- b. Scope test - Does the WTP/WTA increase when the amount of the good increases? Researchers however often found it difficult to establish this.
- c. Debriefing: why did the respondent answer the way he did? For example, if he says he is not willingness to pay, the interviewer should include reasons behind this.
- d. Interviewers effect and protests should be examined
- e. Sample size must be several hundreds at least
- f. Probability of Yes equation should have several significant explanatory variables