

## **CONTINGENT VALUATION METHODS: POSSIBILITIES AND PROBLEMS**

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## 1. INTRODUCTION AND BACKGROUND

The production of transport services can generate a number of different types of externalities some of which represent benefits while other ones appear as external costs. In particular, it has been demonstrated in many studies that transport can engender adverse environmental impacts (loss of environmental resources) along with safety effects (loss of human capital resources). Tables 1 and 2 illustrates the importance of transport on emissions and accidents.

Table 1. Pollutant emissions in the Federal Republic of Germany by groups of emission sources, 1990.

	CO	SO <sub>2</sub>	NO <sub>x</sub>	CH	Dust
Power stations/ heating stations (%)	1	38	14	1	10
Industry (%)	16	40	11	5	53
Households and small consumers (%)	8	14	4	3	10
Transport (%)	75	8	71	51	27
Total (million tonnes)	8.4	1	2.7	2.6	0.3

Source: Rothengatter (1993, p. 97). The original source is DIW (1991) "Verkehr in Zahlen", issued by the Federal Minister for Transport.

Table 2. Incidence of accidents in Europe, 1967-86

	Accidents causing death or injury	Number of injured	Number of deaths
Belgium	1284749	1752708	49214
Denmark	310267	395402	17698
France	4682556	6546812	265912
Federal Republic of Germany	7149218	9617939	285364
UK	5140376	6652383	131008
Greece	390251	543196	26961
Ireland	117678	172356	10569
Italy	3361920	4594801	177258
Luxembourg	31711	42440	1923
Netherlands	1093404	1207178	47585
Total	23562130	31525215	1013492

Source: Rothengatter (1993, p.95).

The type of environmental impacts engendered by transport in urban areas include:-

- noise & vibration;
- atmospheric pollution;
- land & water pollution;

- visual intrusion;
- severance & barrier effects;
- amenity/ townscape.

Apart from these local environmental impacts transport involve also strategic impacts. The latter type of impacts are more difficult to measure because of a weaker link. In the following the focus will be on the local environmental impacts.

Optimal allocation of resources to various purposes require that the external costs associated with these impacts are taken into account. The problem is that the goods associated with these impacts are non-marketed such that a traditional market valuation is not possible. Therefore, it is necessary to provide an alternative valuation of these impacts. A number of approaches towards the valuation of non-marketed goods have been developed in recent years including (see APAS (1996)):

#### Implied market decisions

- revealed preferences (RP);
- hedonic pricing;
- travel cost method (TCM);

#### Experimental market techniques

- stated preferences (SP);
- contingent valuation method (CVM);

#### Surrogate market methods

- replacement cost method;
- shadow prices;
- surrogate markets.

It should be noticed that the estimation of monetary values serve at least two purposes:-

- internalisation of external costs;
- allowance for inclusion of externalities in transport infrastructure appraisal.

In principle, monetary values for the external effects allow for adjusting the market signals such that these reflect social costs rather than private costs. This would correspond to the current trends concerning a market oriented approach towards the external effects engendered from transport. Inclusion of externalities in transport infrastructure appraisal would provide an improved decision-making basis taking into account the widest possible set of impacts. As such monetary valuation of the external effects can be included within a cost-benefit analysis based approach to transport infrastructure appraisal (see Glaister & Layard (1994)). This paper will focus on one of the above mentioned valuation methods, contingent valuation method (CVM). The paper will provide an overview of CVM and examine which externalities are appropriate to be evaluated using this method (section 2). The various problems and possibilities which CVM involve will be outlined (section 3). Section 4 concludes with final remarks and suggestions for further research.

## 2. CONTINGENT VALUATION METHOD

Contingent valuation method (CVM) is a questionnaire based valuation technique whereby willingness to pay (WTP) or willingness to accept (WTA) are directly obtained from the respondents with respect to a specific good. As such the technique is applicable in all circumstances. CVM has mainly been used with respect to non-marketed goods and in particular for environmental goods/ resources. In this context a hypothetical market for a non-marketed good is defined and the respondent is requested to specify their WTP's (or WTA's), see O'Doherty (1996). In the following we will focus on CVM in relation to eliciting monetary values for environmental goods rather than non-marketed goods in general. For example, a CVM study could examine the ex-ante value obtained from a project reducing air pollution for a specific area; the respondents in such a study would be asked how much they would be willing to pay for the reduction in air pollution.

A CVM study involves interviews with the participants which can be undertaken as face-to-face, mail or telephone based. The typical CVM study starts with informing the participants about the environmental resource in focus (e.g. air quality) along with information about the proposed change in the environmental resource and the procedure to be used to finance the proposed change in the environmental resource. This information is provided in order to familiarise the respondents about the change to be evaluated such that the possibility for valid and reliable answers is enhanced. On the basis of this information the respondents are asked about willingness to pay. Usually, a series of follow-up questions are included in order to confirm the given WTP (or WTA) as well as provision of socio-economic background information (gender, age, employment, income). This background information can be utilised to examine their relationship to WTP, e.g. the extent to which willingness to pay depends on income could be tested.

The question concerning the willingness to pay can be structured in different ways, where the main forms include (see Jensen (1995)):-

- open ended;
- dichotomous choice;
- bidding games;
- payment card based forms.

Open ended based WTP would be formulated as 'what is the maximum you would be willing to pay for [the specified change in the environmental good]?' . Dichotomous choice formats involve two questions, where the first one concerns whether or not there is a willingness to pay for a specified change in the environmental good. This question should be answered with a yes or no, if yes then a question is asked concerning whether the WTP is equal to a specified amount. For bidding games the participants are asked whether they are willing to pay a specified amount. If yes, then another question is asked about willingness to pay a specified amount higher than the previous amount. This process continues until a no answer is obtained. Participants in payment card based forms of CVM are shown a card on which a range of payments is illustrated. The participants should then identify the payment on the card which corresponds to their willingness to pay. Obviously, other methods exist which can be used to elicit WTP, e.g. as combination of the above discussed main forms.

An important issue is whether the different procedures used to elicit WTP within CVM result in different WTP-estimates. O'Doherty (1996) refers to a study where it was shown that responses given to open-ended and the dichotomous choice formats were significantly different.<sup>1</sup> This difference was only found for public goods such as environmental goods. No difference for private goods markets

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<sup>1</sup> See Kealy, M.J. & Turner, R.W. (1993) A Test of the Equality of Closed-Ended and Open-Ended Contingent Valuations ; American Journal of Agricultural Economics, vol. 75, no. 2, pp. 321-331.

could be found. It is likely that such differences can be related to the lack of familiarity with WTP questions concerning changes in the level of environmental goods. Another study<sup>2</sup> referred to in O'Doherty (1996) shows a reasonable level of convergent validity both between WTPs for different forms of elicitation within CVM as well as in comparison with indirect valuation methods. The study examined the valuation of a 50% change in perceived pollution levels with reference to Israel. Table 3 lists the obtained WTP's (measured as compensating surplus).

Table 3. Direct and indirect valuations of a 50% change in perceived pollution levels (mean annual sum per household in Israeli currency - NIS).

CVM	
Open ended	37.7
Modified Iterative Bidding	67.8
Binary Choice	66.2
Indirect	
Health Production	90.0
Cost of Illness (bed day)	185.0

Source: O'Doherty (1996, p. 62). Original source is Shechter (1991) A Comparative Study of Environmental Amenity Valuations ; Environmental and Resource Economics; vol. 1, no. 2, pp. 129-155.

However, these results still show that WTP's can show variation with respect to the elicitation method used. From a more general point of view it is important to ensure that CVM results are not caused by the specific characteristics of a given study, e.g. interview format, order of questions, payment vehicle, sample size, statistical techniques. Otherwise, the use of CVM results to internalise external costs could prove problematic.

Another important issue is the extent to which obtained WTP's vary according to the level of change in the environmental good concerned. For example, would the WTP for improved air quality depend on whether the proposed change is 10% or 50%. If preferences for environmental goods are similar to those held for standard goods then it should be expected that higher levels of the environmental good are preferred to lower levels such that higher WTP's should be recorded with higher levels of the environmental good. A number of CVM studies have reported a tendency towards less than expected change in WTP compared to the change in the level of change associated with the environmental good. For example, Schkade and Payne (1993) include a CVM study on WTP's for preventing waterfowls dying due to contact with oil from waste-oil holding ponds in the US. Participants in the study were randomly given information about number of water fowls killed (the number killed could take one of three levels: 2000, 20000, 200000). Table 4 reports on the WTP responses by damage level.

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<sup>2</sup> See Shechter, M (1991) A Comparative Study of Environmental Amenity Valuations ; Environmental and Resource Economics ; vol. 1, no. 2, pp. 129-155.

Table 4. Waterfowl protection: WTP responses by damage level (US\$)

	2000 bird deaths	20000 bird deaths	200000 bird deaths
Including zeros			
Sample size	32	32	32
Mean	84.2	62.5	121.8
Median	25	30	50
Excluding zeros			
Sample size	28	29	30
Mean	93.3	68.9	134.0
Median	25	50	60

Source: Schkade and Payne (1993, p. 283).

Likely explanations for such a pattern include the respondents' viewing CVM answers as a way to signal their larger concerns about the environment and the possible link between WTP answers and charitable donations.

An important aspect of CVM is that in addition to consideration to use values, non-use values can also be taken into account. The correct specification of non-use value is crucial in order to avoid double-counting. Diamond and Hausman (1993) discusses the concept of non-use value within CVM emphasising that focus should be on those non-use values which are unrelated to human use of an environmental good rather than non-use values related to an individual's own use or the enjoyment of other individuals' use. This component appear as significant compared to the other forms of non-use values.

The use of CVM to obtain monetary values should be restricted to those elements which are familiar to the respondents. Otherwise, the risk is that WTP values do not reflect preferences but rather guesses given the hypothetical character of the analysis. Furthermore, it is important to clarify to the respondents what the requested WTP should refer to. Therefore, a more concrete and limited valuation task is likely to provide more reliable WTP's. On this basis CVM could be used to provide monetary values for local environmental impacts from transport including the ones listed on page 3, thereby focussing on those elements which the respondents have knowledge about. It should be noted that monetary values on emission changes would appear to be too abstract to be elicited within CVM. However, as noted above values concerning air quality changes could be derived from CVM. Ideally, CVM values are confronted with those from other valuation techniques in order to ensure that values used are not the result of the methods used but rather reveal general properties.

### 3. POSSIBILITIES AND PROBLEMS WITH CVM

Contingent valuation method entails a number of characteristics which allows for enhancing the extent to which changes to environmental goods can be assessed on a monetary basis. However, the method also involves a number of problems and short-comings. Below, the possibilities and problems of CVM will be outlined.

The possibilities created by CVM include the following:-

- valuation can reflect use as well as non-use values;
- CVM focuses on ex-ante valuation;
- direct estimation of willingness to pay;
- experimental approach allows for valuation of a variety of different environmental goods.

As noted in section 2, CVM values will reflect total value rather than use value only. In this way it is possible to obtain a comprehensive measure for the value associated with a specific environmental good. The focus on ex-ante valuation provides a useful input to decision making processes where concern is about a potential policy change; this should be contrasted to travel cost and hedonic pricing methods where the values in general are derived on an ex-post basis. Direct estimation of willingness to pay can provide useful information about the values for a specific environmental good within a sample of a given population being derived from the active involvement of the respondents. The experimental approach in CVM extends the valuation of environmental goods which cannot be assessed through indirect valuation methods. However, this is subject to the valuation task relating to a well-perceived situation or experience.

Various studies into CVM have identified a number of problems, see e.g. Diamond, Hausman, Leonard and Denning (1993) and O'Doherty (1996). Below, these problems will be presented:-

- large difference between willingness to pay and willingness to accept measures;
- controlling the validity and reliability of estimates;
- strategic behaviour in responses;
- hypothetical nature of survey;
- survey design related issues.

An often cited problem in relation to CVM is large differences between willingness to pay (WTP) and willingness to accept (WTA). In standard situations WTP is lower than WTA, although the difference should be small provided the income effects are small. Diamond and Hausman (1993) argue that the income effects in relation to CVM studies can be expected to be small due to the money values involved and the fact that CVM surveys have indicated that obtained WTP's do not increase in proportion to income (see Diamond, Hausman, Leonard and Denning (1993)). The response from CVM proponents have mainly approached this problem by arguing that environmental goods contain use as well as non-use values (including existence values). This could imply inflated WTA values while WTP values could, in theory, be elicited correctly (see O'Doherty (1996)). Furthermore, it can be argued that the value function for losses is steeper than for gains, thereby providing for a difference between WTA and WTP. Finally, it should be noted that market prices are the result of repeated valuations while CVM often represents one-off valuations; this could provide the basis for caution in the evaluation phase.

The validity of CVM values is difficult to determine given that the true WTP is often unknown. If the true WTP was known there would no reason to undertake a CVM study. The best approach is to examine carefully the questionnaire design in order to ensure that the questions are clear and reflect the situation to be examined. Furthermore, indications about the validity of CVM values can be provided through comparisons to the values obtained from other methods, e.g. revealed preference and hedonic pricing methods. The lack of information about the true WTP is also a problem in relation to

controlling the reliability of the obtained CVM values. Indications about reliability can be obtained through undertaking a given CVM study at different points in time, the so-called test-retest situation. This can provide information about the extent to which similar CVM values are obtained given no change in other conditions.

The structure of CVM surveys can lead to strategic behaviour among the respondents. For example, if the respondents perceive that the environmental good is likely to be provided irrespective of the stated preferences then there could be incentives to free-riding implying lower WTP's. On the other hand if respondents perceive that the provision of the good is contingent on the stated preferences combined with the impression that eventual payment is a fixed amount then that could lead to overstating the true preferences. O'Doherty (1996) argues that carefully survey design can minimise the extent to which strategic behaviour occurs. For example, free-riding can be eliminated by ensuring that the participants do not have the impression that the good in focus will be provided irrespective of the stated preferences.

The hypothetical character of CVM could lead to problems if the respondents have difficulties in coping with such a survey. It could lead to irresponsible behaviour giving too high or too low values because of uncertainty concerning the good in question and because the hypothetical character could be perceived as implying that responses given have no consequences. To a large extent this problem can be limited through appropriate survey design and using CVM in relation to situations/ experiences which are familiar and well-perceived.

It should be noticed that improving a CVM study is not done through provision of more information only, of importance is how the information is perceived by the participants.

The format used to elicit preferences can induce biases in the stated values. For example, the iterative bidding games can involve a so-called starting point bias due to the choice of a specific starting value for the WTP's. On the other hand the open-ended format can result in a large number of zero values along with very large values. Therefore, the selection of the format for eliciting preferences is important in order to minimise the presence of biases.



#### 4. CONCLUSIONS

This paper has highlighted a number of issues in relation to the use of contingent valuation method (CVM) to provide monetary values for changes in environmental goods. The analysis suggests that CVM can be seen as a useful tool to monetarise environmental impacts associated with transport. It is important to stress that CVM should only be used in relation to environmental impacts which are well-perceived by participants in such surveys. Therefore, the main role of CVM is to provide monetary values for local environmental impacts.

CVM entails a number of advantages with respect to monetarisation of environmental impacts:-

- valuation can reflect use as well as non-use values;
- CVM focuses on ex-ante valuation;
- direct estimation of willingness to pay;
- experimental approach allows for valuation of a variety of different environmental goods.

However, the method also involves a number of problems:-

- large difference between willingness to pay and willingness to accept measures;
- controlling the validity and reliability of estimates;
- strategic behaviour in responses;
- hypothetical nature of survey;
- survey design related issues.

The presence of these potential problems indicates the importance of survey design along with correctly perceived information by the participants in such surveys.

A number of issues remain for future research including (1) clarification of the extent to which CVM values reflect preferences from an economic theoretic point of view, (2) possibility for obtaining separate measures on use and non-use value rather than total value and (3) development of optimal procedures to elicit willingness to pay values.

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