

# THE CHOICE OF ELICITATION METHODS IN CVM AND THEIR IMPACT ON WILLINGNESS TO PAY IN ENVIRONMENTAL ASSESSMENT

by

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The choice of the question format constitutes one of the major exercises in contingent valuation method (CVM) studies. However, although various methods are available, none of these are considered to be perfect. This paper aims to examine the effects of varying the elicitation methods on willingness to pay (WTP) of the respondents by summarizing the findings of two environmental assessment case studies conducted on Nagasaki City. Three types of elicitation methods are applied in the case studies: open-ended, single bounded dichotomous-choice and double-bounded dichotomous-choice questions. Results indicate that free riding and lack of base for answering question leads to underestimation of WTP under open-ended format. Whereas, the anchoring effect is presented in dichotomous choice format where the bid level provided raises the probability of accepting it. Based on the drawbacks of both the methods, recommendations are provided for using a new format of question to avoid the demerits.

**Key Words:** elicitation methods, willingness to pay, contingent valuation method

## 1. INTRODUCTION

There are different ways to ask willingness to pay (WTP) questions in contingent valuation (CV) surveys, which are known as elicitation methods. Presently four types of elicitation methods are commonly used in CVM studies e.g., open-ended (OE), bidding game (BG), single-bound dichotomous-choice (1DC) and double-bound dichotomous-choice (2DC). Among them especially dichotomous-choice (DC) format is the most widely used one. Follow-up questions are also used to increase the precision of the estimate with DC question. The NOAA blue ribbon panel advocated this method as the most appropriate one in most circumstances<sup>1)</sup>. While among others bidding game (BG) approach has been almost deserted because it tends to result in a starting point bias. However, all these methods of asking questions have their relative advantages and disadvantages and none is free from criticisms. A summary of the characteristics of the

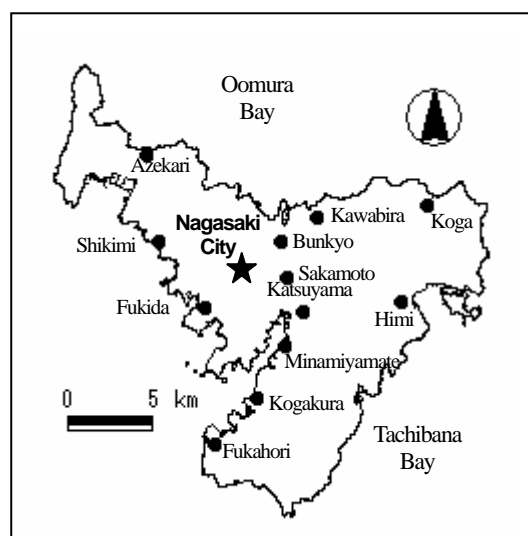


Fig.1 Survey area in Nagasaki City

most commonly used elicitation methods is provided in **Table 1**. In this context, this study is a modest attempt to study the impact of different elicitation methods on willingness to pay of the same respondents by using the CVM study data of two environmental assessment case studies.

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**Table 1** Elicitation methods used in CV survey

	Open-ended question	Dichotomous-choice method	Double Bounded Dichotomous-choice method
How-To's	Respondents are asked to state their maximum WTP for the amenity to be valued	Respondents are asked if they are willing to pay single randomly assigned amount on all-or-nothing basis	Respondents are asked an additional question if they would pay a higher or lower amount
Number of Question	Single	Single	Iterated series of question
WTP Obtained	Actual	Discrete indicator of WTP	Discrete indicator of WTP
Major Advantage	Provides Straightforward actual valuation of amenities	Much more familiar to the respondents because of the similarity to the market condition <sup>2)</sup>	More statistical efficiency can be achieved than that of DC as additional information can be elicited <sup>3)</sup>
Major Disadvantage	Might lead to understatement of WTP due to lack of knowledge of costs and benefits and free riding <sup>4), 5)</sup>	'Framing' or 'Anchoring' effect arising from the probability of accepting the bid level due to ignorance about true valuation <sup>6)</sup>	Danger that the respondents exposure to the first offer would influence them to accept the follow-up offer.

**Table 2** Survey description

	HTB Study	Public Park Study
Location	Nagasaki City	Nagasaki City
Questionnaire Distributed	950	1000
Questionnaire Returned	232	194
Elicitation Methods Used	OE, 1DC, 2DC	OE, 1DC, 2DC

## 2. METHODS AND DATA

Database of the following two CVM case studies are used to examine the effect of elicitation methods on the WTP of the respondents (see **Table 2** for survey details). Both of these studies have Nagasaki City as their sample area and attempted to estimate the value of sustaining and increasing recreational parks (see **Fig.1** indicating the survey area).

As a methodology statistical model has been constructed by dividing the elicitation methods into two groups OE and DC responses. 1DC and 2DC are merged into a single model of DC, as same 1DC model can be extended to 2DC with the basics remaining the same<sup>3)</sup>. Also the 'anchoring effect' (the probability of the respondent accepting the offered bid) is common in all DC formats. Thus 2DC, 3DC etc. are a simple extension to the DC bidding game and therefore the drawbacks of DC also applies<sup>7),8)</sup>.

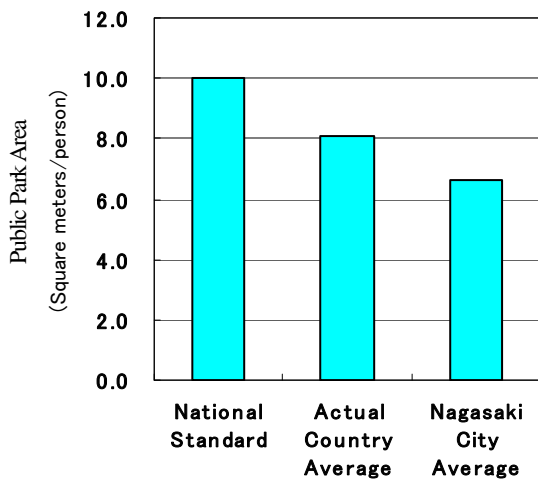
### (1) Huis Ten Bosch Study

Huis Ten Bosch (HTB), meaning "House in the Forest" in Dutch, is one of the biggest theme parks in Kyushu, Japan. It is a famous private recreational theme park opened on March 1992 at an approximate cost of ¥ 300 billion, created by transforming 152 hectares of industrial wasteland through various environmentally affable mechanisms<sup>9)</sup>.

Modeled after a Dutch town, the resort and theme park was once considered as popular as Tokyo Disneyland. Huis Ten Bosch attracted 4.25 million visitors in 1996 at the peak of its popularity, and 3.55 million in year 2001.

Although Huis Ten Bosch marked a bright start by attracting visitors not only from Japan, but also from neighboring Asian countries, this trend did not continue. HTB started to fall into financial difficulties for the following reasons<sup>10)</sup>.

Accordingly, HTB revenues continued shrinking and stood at about ¥35 billion in 2001, down 40 percent from the peak annual revenues of about ¥49.6 billion in 1996, while the liabilities stood at about ¥229 billion, including about ¥180 billion in loans<sup>11)</sup>. Eventually on February 2003, operators filed for protection from its creditors under the Corporate Rehabilitation Law and currently efforts are continuing for its revival. Accordingly, on this background we have conducted a CV study to



**Fig.2** A comparison of public park area per person

estimate the socio-environmental value of Huis Ten Bosch.

**(2) Public Park Study**

Public parks provide different benefits to the community such as: recreational benefits, economic benefits, environmental benefits, safety benefits and so on. Especially in a hillside city like Nagasaki, where plain spaces are hard to find, public parks have more wide uses. But unfortunately adequate space or number of public parks are lacking in Nagasaki City, which also can be considered as one of the important reasons for making the Nagasaki city poorly ranked urban city (497th C grade city among 678 urban cities of Japan<sup>12</sup>). The ratio of public park per square meter (PPSM) is alarmingly low in Nagasaki City as compared to the national standard and actual national average of Japan. As we can see in **Fig. 2**, national standard of public park is 9.5 PPSM and the actual national average is 8.1 PPSM. Whereas, in Nagasaki city it is 6.6 PPSM.

On the basis of the background portrayed above, it

is interesting to investigate how the residents of Nagasaki City are viewing the need for public parks, in order to plan for the increase and improvement of it. And one common and more easily understood method to articulate the need of some public good, is to express it in monetary terms by valuing it. Consequently, in this study we are going to estimate the willingness to pay for preserving the nearest public parks as a means to express the urge for the maintenance and development of public parks in Nagasaki City. As a method for estimating the WTP, we are going to use contingent valuation method (CVM).

**3. FINDINGS**

The findings of the study are summarized through **Table 3** and **Figs. 3 and 4**.

**(1) Open-ended Format (HTB Study)**

Under the OE elicitation method the mean WTP is estimated as ¥2,760 for the entire sample (95% CI=¥2,150~¥3,370) (see **Table 3**). All those who refused to pay anything are treated as having zero WTP. But as common to the OE format the standard deviation is revealed to be very high. A model is constructed to check the validity and explanatory power of the related variables. Accordingly, the double-log form model derived is as follows:

$$LWTP(OE) = 5.854 + 0.219LINC \quad (1)$$

(7.192)    (1.547)

Where,

LWTP (OE) = Natural log of open-ended WTP response

LINC = Natural log of the respondent's income

**Table 3** Mean WTP under various elicitation methods

Elicitation Method	HTB Study			Public Park Study		
	Mean WTP (¥)	SD	95% CI (¥)	Mean WTP (¥)	SD	95% CI (¥)
OE	2,760	4,230	2,150-3,370	4,660	5,490	3,880-5,440
1DC	3,360	330	2,700-4,020	4,960	240	4,490-5,430
2DC	3,520	320	2,890-4,150	5,370	340	4,700-6,040

Numerals in the parenthesis are t values.

The variables shown above are significant at least at 0.10 level. Other variables such as: visit and demographic variables sex and age were also inserted in the model, but they were not significant. The  $R^2$  (adj.) = 4%. Thus it indicates that the explanatory variables are not properly explaining the OE willingness to pay.

## (2) Dichotomous-choice Format (HTB Study)

Under the DC elicitation method the mean WTP is estimated as ¥3,360 (95% CI=¥2,700-¥4,020) (see **Table 3**). The standard deviance reduced significantly compared to the OE format. With dichotomous structure of the dependent variable, the model can be estimated through a non-linear probability model and the most common one is the logit model<sup>13</sup>. Accordingly a logistic model is constructed to check the validity and explanatory power of the relevant factors is as follows:

$$\ln[\text{prob}(\text{yes})/\{1-\text{prob}(\text{yes})\}] = 6.670 - 0.6272\text{LBID} \\ (10.686) \quad (10.688) \quad (2)$$

Where,

LBID = Natural log of the proposed bid value

Numerals in the parenthesis are t values.

The variables shown above are significant at least at 0.10 level. The overall explanatory power of the model is higher than OE format. The overall model is significant at the 0.01 level. The model reasonably predicts 71% of the responses correctly. The  $R^2$  = 8.88%. Thus it indicates that the explanatory power of the variables increased in the DC format. But the influence of the bid level variable remains highest, indicating the presence of anchoring effect, as it alone can explain almost 71% changes in the willingness to pay.

## (3) Open-ended Format (Public Park Study)

In this study, OE format mean WTP is estimated as ¥4,660 for the entire sample (95% CI=¥3,880~¥5,440) (see **Table 3**). Also like the

HTB study, the standard deviation is high. A model is constructed to check the validity and explanatory power of the related variables. Here the double log form model derived is as follows:

$$\text{LWTP (OE)} = 7.781 + 0.285\text{VISIT} + 0.003\text{AGE} \\ (7.321) \quad (1.761) \quad (0.571) \\ + 0.059\text{LINC} \quad (3) \\ (0.378)$$

Where,

LWTP (OE) = Natural log of open-ended WTP response

VISIT = Whether the respondent went to visit public parks at least once in a month. Yes=1, No=0

AGE = Age of the respondent's in years

LINC = Natural log of the respondent's income

Numerals in the parenthesis are t values.

The variables shown above are significant at least at 0.10 level. But the overall explanatory power of the model is as usual very low. The  $R^2$  (adj.)= 0.5%.

## (4) Dichotomous-choice Format (Public Park Study)

Under the DC elicitation method the mean WTP is estimated as ¥4,960 (95% CI=¥4,490-¥5,430) (see **Table 3**). The standard deviance reduced highly as compared to the OE format. The logistic model constructed to check the validity and explanatory power of the relevant factors is the following:

$$\ln[\text{prob}(\text{yes})/\{1-\text{prob}(\text{yes})\}] = 1.883 - 0.665\text{LBID} - 1.290\text{VISIT} \\ (0.485) \quad (5.226) \quad (14.011) \\ + 0.054\text{AGE} + 0.002\text{INC} \\ (4) \\ (11.824) \quad (12.335)$$

Where,

LBID = Natural log of the proposed bid value

INC = Income of the respondent household (in ten thousand yen)

Numerals in the parenthesis are t values.

Rest of the variables are same as explained before. The variables shown above are significant at least at 0.10 level. The overall explanatory power of the model is higher than OE format. The model reasonably predicts 71.94% of the responses correctly. The  $R^2 = 15.99\%$ . As also seen in the HTB study, influence of the bid level variable remains highest, indicating the presence of anchoring effect, as it alone can explain almost 60% changes in the willingness to pay.

#### 4. DISCUSSION

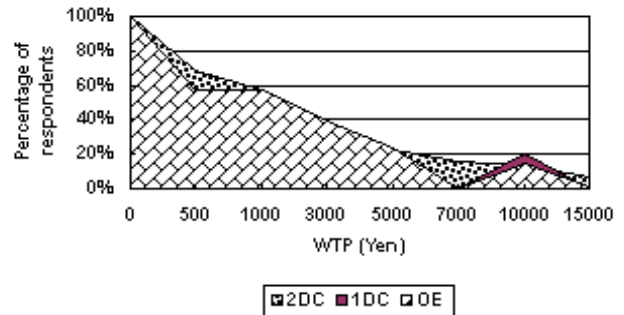
From the ongoing discussion the following points can be put forward:

- (1) From the results of both of the case studies, we have seen that under OE question format willingness to pay (WTP) is lower and the variance is higher leading towards the possibility of underestimation of the true WTP (see **Table 3** and **Figs. 3-4**).
- (2) Whereas under dichotomous-choice question format the WTP is higher and the variance also decreases.
- (3) As shown in **Table 4**, extrapolating the average WTP calculated to the total number of households of Nagasaki City makes the impact of elicitation methods on aggregate environmental assessment more clear. The range of variation is in between ¥486-619 million in HTB study and ¥820-945 million in public park study. This indicates the larger impact of choosing elicitation method on environmental assessment. But the difference is not so significant as evident in other relevant studies<sup>3)</sup>.

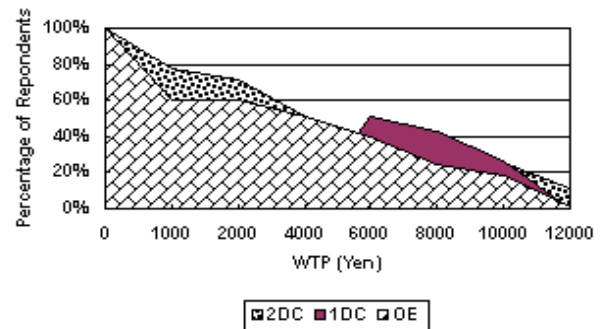
**Table 4** Aggregate willingness to pay  
(In million yen)

Elicitation Methods	HTB Study	Public Park Study
OE	486	820
1DC	591	873
2DC	619	945

*Note:* Average WTP of Table 3 is multiplied by the total



**Fig. 3** Effect of elicitation method on WTP for HTB case study



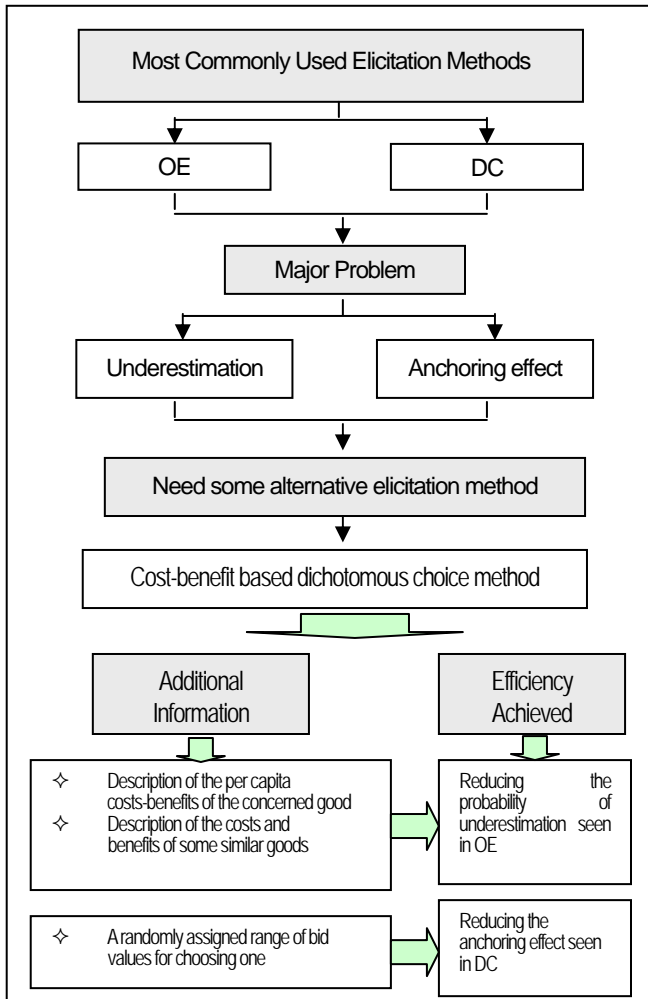
**Fig. 4** Effect of elicitation method on WTP for public park case study

*number of households of Nagasaki City<sup>14)</sup>.*

- (4) From the model construction statistical inaccuracy of the OE format is again revealed due to poor ability of the explanatory variables to explain the WTP.
- (5) DC format model construction showed more relative explanatory power of the related variables, but highly influenced by the bid level.

#### 5. CONCLUSION

From the results of the study we have seen that both OE and DC approach have their relative advantages and disadvantages. Lack of knowledge of cost-benefit and free riding lead to understatement of WTP under OE question format. Whereas, although DC format is free from many of the demerits of OE format, still the ‘framing’ or ‘anchoring’ effect arising from the probability of accepting the bid level due to ignorance about true valuation is present. Thus to sum up, both OE and DC format are prone to biases and may lead to improper environmental assessment, as the



**Fig. 5** Alternative elicitation method

respondents might base their answers without having

adequate knowledge about the actual cost-benefit behind the valuation. In order to avoid this, we would like to propose an alternative method, which are expected to overcome the demerits of the two above stated methods.

As shown in **Fig. 5**, in the proposed method additional information on cost-benefit of the concerned good and other relevant good would be provided in order to assist the respondent's decision in numerical form. Also a number of randomly assigned bid values would be provided to reduce anchoring effect arises under DC format. In this respect, this paper tested the accuracy of OE and DC question format in eliciting WTP. Based on the findings of this study, we would like to test the accuracy of our proposed alternative question format in our future environmental assessment studies.

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