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the Shimanto river, Japan**

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### Abstract

In Japan, dramatic decrease in population and tax revenues of local areas have made the preservation of precious local environmental resources difficult. Although people who live in urban areas have a general consciousness toward preservation of such resources, the amount they are willing to pay and how this consciousness can be realized remain vague. The aims of this study are to estimate such willingness to pay (WTP), to consider the applicability of the contingent valuation method, and to suggest a funding scheme for conservation. Estimation is focused on the Shimanto river, famous as the last clear stream of Japan. Consideration includes a comparison of non-response rate between questionnaire formats and a test of scope insensitivity. Comparison between the private goods format and the referendum format is noteworthy because most Japanese do not have the experience of participating referendum voting on a specific issue. The test of scope insensitivity shows that mean WTP for water quality improvement of the entirety of the river is significantly larger than that of only part. However, weak sensitivity calls for careful benefit transfer. Finally, the paper examines the significance of WTP from a policy perspective. To actualize the will of residents of urban centers for conservation of local environmental assets, it is necessary to establish an institution that can collect the cost for conservation directly from beneficiaries.

Keywords: Contingent valuation; Nonuse value; Cost-benefit analysis

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## 1. Introduction

Nearly 80% of the Japanese population lives in urban areas. Dramatic decrease in local population and tax revenues of local areas have made the preservation of precious local environmental resources difficult. Although people who live in urban areas have a general consciousness toward preservation of such resources, the amount they are willing to pay and how this consciousness can be realized remain vague. The first aim of this paper is the measurement of willingness to pay (WTP) by urban residents for water quality improvement of the Shimanto river, which is a local environmental resource famous as the last clear stream in Japan. The second aim of the study is analysis of the contingent valuation (CV) method. Comparison between payment vehicles, and the test on scope insensitivity enable the discovery of a better technique for elicitation of WTP. Finally, the paper considers the significance of WTP from a policy perspective. As long as there exists no institutional support for the use of these evaluative results in policy, this study, and those like it, have little significance.

Monetary valuation of environment in Japan does not enjoy the popularity evident in the United States. The main reasons are twofold: institutional and historical. Japanese administrators have no institutional requirement to examine the benefits of public projects or of environmental policy. Legislation in the U.S., on the other hand, has accelerated the demand for environmental evaluation technique. Executive Order 12291 calls for consideration of benefit and cost in essential new regulations, and CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) and OPA (Oil Pollution Act) recognize in litigation monetary valuation of damages to natural resources, including intangible assets. In Japan, no such legislation exists and public projects and regulations are implemented without much consideration on efficiency and intangible public wealth.

Secondly, even before environmental policy began in Japan, intensive industrial pollution had already taken many victim's lives and caused irreversible injuries. In many cases, regulations were implemented regardless of compliance costs, and the priority of regulation was given only to substances which caused severe health disorders and fatalities. In other words, it was a situation that demanded urgent regulation. The frameworks of cost-benefit analysis or of efficiency were not appropriate. This allopathic way of regulation seems to be unchanged and linger until now. However, a more efficient policy seems to be necessary for considerable aspects of today's environmental

problem in Japan.

Although a number of empirical studies have been made on environmental evaluation in Japan recently, little is known about the applicability of these methods. The main purpose of this paper is to consider the applicability of the Contingent Valuation (CV) method in Japan. Our survey is virtually the first in Japan to apply the CV technique to derive the WTP of urban residents for preserving a precious and well-known natural asset<sup>1</sup>.

## 2. Elicitation and estimation

### 2.1 The Shimanto river

The Shimanto river, well-known as the last clear stream in Japan, runs through the western part of Kouchi prefecture in Shikoku (Fig 1).

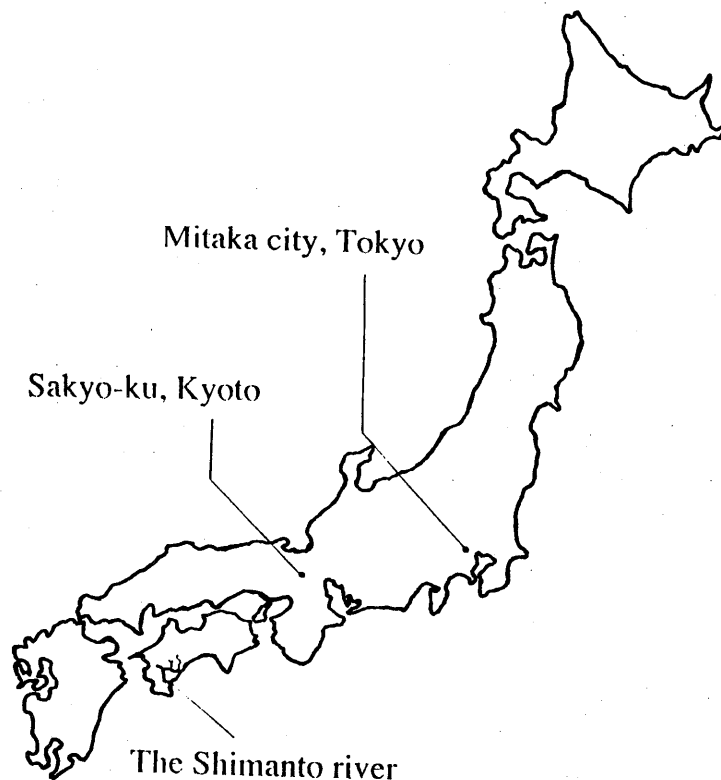


Figure 1 The Shimanto river, Kyoto and Tokyo

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<sup>1</sup> Though Hagiwara and Hagiwara (1993) elicited WTP for water quality improvement motivated by nonuse value, they did not specify the valuation object.

Its slow and meandering flow, as well as abundant nature along the riverside, has long won it popularity among canoeists. It supplies a habitat for biological resources such as ayu fish, eel, and eighty species of dragonfly.

Recently however, those hitherto abundant resources are said to be declining mainly because of the modernization of local facilities. For example, human excrement, rather than be recycled as fertilizer, is now flushed down toilets, and subsequently into the river; further the growing use of modern chemical detergents has had additional detrimental effect. Using the CV technique, our questionnaire elicits to what degree distant urban residents are willing to pay for clean up of the river.

## **2.2 Elicitation method**

By way of interview, we used the CV method to elicit the amounts people would be willing to pay for the clean up of the river. Dichotomous choice format, which asks respondents whether (s)he would purchase particular environmental goods or vote yes / no to particular referendum, seems to be de facto standard in recent studies. We applied a double-bounded dichotomous choice format, derived from the single dichotomous choice format. In this approach, two yes / no questions are posed to respondents. If the respondent answered "no" to the first question, another question is asked using lower price chosen from a prespecified list. If answer was yes, higher price is suggested in the second question. This format has been demonstrated to improve the statistical efficiency in comparison with the single version of dichotomous choice approach (Hanemann et al. 1991).

An in-person survey of randomly sampled households in Mitaka city of Tokyo (294) and Sakyo-ku of Kyoto city (274), a total of 586, were conducted in August of 1995. 440 households (Mitaka 247, Kyoto 193) returned complete responses to the questionnaire. Incomplete responses were regarded as unreliable, and we have omitted them from calculations. Among the valid respondents, 92.05% have previous knowledge of the Shimanto river before the interview, and in 18.64% households the member, or members, had visited there.

Following brief explanation of the Shimanto river with pictorial panels and photographs, respondents were posed the WTP question, which asked willingness to pay specific amounts suggested. Two types of questionnaires were prepared for each sub sample group, a referendum format type and a private goods format type. The former ask respondents to vote yes or no on a project that would improve the water quality of the

Shimanto river but hypothetically imposed on the respondents randomly assigned amounts of tax. The private goods format queried whether (s)he would buy 100kg of charcoal which could improve 500m × 500m portion of the river (0.01% of the whole river basin) at a randomly assigned price.

### 2.3 Estimation

We used survival data analysis for estimating parameters (Nelson 1982, Carson et al. 1992), a method is widely used for calculation of the life span of manufactured products.

Collected data results from the following cumulative distribution function.

$$F(y) = \Phi\left(\frac{y - \mu}{\sigma}\right),$$

where  $y$ ,  $\mu$  and  $\sigma$  are the values of WTP, and location and scale parameters.

First suggested price and second suggested prices are interval. If the response of a subject changes between  $[\eta_{ij}, \eta_{ij-1}]$ ,  $y_i$  is larger than  $\eta_{ij-1}$ , and less than  $\eta_{ij}$ ; if the response unchanged,  $y_i$  is larger than  $\eta_{ij}$ , or less than  $\eta_{ij-1}$ .

Then, estimate parameters which maximize the log-likelihood function,

$$\text{Log } L = \sum_{i=1}^n \ln \left[ \Phi\left(\frac{\eta_{ij} - \mu}{\sigma}\right) - \Phi\left(\frac{\eta_{ij-1} - \mu}{\sigma}\right) \right].$$

One can maximize this likelihood function by assuming particular distribution for  $\Phi$ .

### 2.4 General survey design strategy

The general questionnaire design strategy followed the NOAA (National Oceanic and Atmospheric Administration) panel guideline, the latest guide for applying the CV technique to natural resource damage assessments under OPA (Arrow et al. 1993).

However, there was a single point which does not agree with the guidelines. We chose not to prepare any explicit question that asks the reason for voting yes / no. This was not a refusal to recognize the importance of reasons for purchase, but rather, that there is no sound way to exclude an array of responses that the question provokes. People usually decide to purchase goods and vote yes / no for multiple reasons, thus it is not appropriate for the analyst to drop any sample by one reason. We feel that dividing WTP within a

subject among reasons or motivation is also inappropriate. Cognition and value formation process is very different among people, so that dividing seems to be an arbitrary manipulation by researchers. Dividing, to be accomplished successfully, requires strong assumption on preference of respondents. It further has less effectiveness for providing on an actual use of the amount, because cost benefit analysis does not itemize anything for which an individual has WTP.

### 3. Comparison of non-response rate

There are two elicitation vehicles for application of dichotomous choice type of CV questionnaire, referenda and private goods. Comparison between these vehicles is important to understand which is the better measurement technique. Table 1 shows proportions categorized by answer types. The "Don't knows" response rate elicited by the referendum format seems to be higher than that of private goods format.

**Table 1 Proportions categorized by answer types**

	Yes-Yes	Yes-No	No-Yes	No-No	Don't knows
Referendum	32.1%	18.8%	7.8%	31.2%	10.1%
Private Goods	23.4%	11.7%	14.1%	45.1%	5.4%

The latest guideline by NOAA panel on CV recommends the referendum format of elicitation for two reasons. First, it avoids strategic bias. The guide states that "a respondent who would not be willing to pay D dollars has no reason to answer Yes, and a respondent who would be willing to pay D dollars has no reason to answer No." Second, it is realistic: referenda on the provision of public goods are not uncommon in the decision-making procedure in the United States.

The first reason is not specific to referendum format, but rather a general feature of the dichotomous choice type of question. In contrast to the referendum, private goods type of dichotomous choice actually strengthens the avoidance of strategic bias, because it does not allow subjects to imagine on the aggregation of their responses. The second reason seems to be culturally specific. Few Japanese have the experience of referendum voting on particular policy issues. Thus, the rate of respondents who deny the valuation question may be higher with referendum format than private goods format, because of speculative nature of the questionnaire settings. The hypothesis can be stated as



$$H_0 \quad p_1 - p_2 = 0$$

$$H_1 \quad p_1 - p_2 > 0$$

where  $p_1$  is the number of "don't knows" responses to the referendum format and  $p_2$  is the number of "don't know" responses to the private goods format. The test of  $H_0$  versus  $H_1$  can be written in terms of the binomial parameter  $\theta$  where the estimate of  $\theta$  is given by  $p/n$ . For referenda,  $\theta_1 = 0.101 (= 22 / 218)$  and for private goods,  $\theta_2 = 0.054 (= 12 / 222)$ .

In fact, the sampling distribution is the hypergeometric distribution and is approximated by binomial. Test of  $H_0$  versus  $H_1$  shows that the significance level of the observed outcome under  $H_0$  is 0.0546. Thus,  $H_0$  is possibly significant. The result casts some doubts on the equality of "don't knows" response rates between referendum format and private goods format, though it does not invalidate the referendum format in general.

Moreover, the above hypothesis may soon become inappropriate. Recent news on some requests of referenda by residents indicate the change of attitudes in Japan. By law, residents can ask for municipal regulation of referenda with the signatures of 2% of voters. Although they are often denied by the municipal assemblies, the number of such requests is increasing. The request for a referendum on the reclamation of the Nakaumi (an inland sea) of Shimane prefecture is an example of such cases. In Maki town of Niigata prefecture, a referendum on the construction of a nuclear power plant will be held in summer of 1996. This will be the first case of deciding a policy issue by a referendum requested by local residents.

#### **4. Test of scope insensitivity**

##### **4.1 Scope insensitivity**

Kahneman (1986) originated the notion that CV survey results are likely to be insensitive to the scope of the good being valued. He argued that willingness to pay for cleaning-up all the lakes in Ontario of Canada was not much larger than cleaning-up one lake of that province. Following Kahneman, some articles assert specifically the existence of insensitivity (Kahneman and Knetsch 1992, Diamond et al. 1993, Desvousges et al. 1993, Schkade and Payne 1994). These authors regard their findings

as strong evidence for the unreliability of the CV method.

However, others remain unconvinced because of their alleged ill-suited statistical treatment, theoretical misunderstandings, and invalid survey design (Smith 1992, Carson and Mitchell 1995). In addition, Carson (1995) made a long list of studies that find scope sensitivity in CV researches. We will later consider whether or not our data set should be added to this list.

#### 4.2 Test

Table 2 shows numbers of responses to suggested prices.

**Table 2 Data frequency**

		Referendum									
		500	1,000	2,000	3,000	5,000	8,000	10,000	20,000	30,000	50,000
Yes		1	30	31	24	32	30	27	11	11	0
No		7	16	26	21	17	28	27	29	16	6
		Private goods									
		500	1,000	2,000	3,000	5,000	8,000	10,000	20,000	30,000	50,000
Yes		4	27	29	25	24	22	16	10	5	0
No		4	18	42	38	37	37	34	30	14	3

**Table 3 Estimated parameters and point estimates (Weibull)**

	Referendum (N = 210)	Private goods (N = 196)
$\alpha$	10521.1 (6.74)	5484.9 (7.04)
$\beta$	0.64 (9.59)	0.60 (8.68)
Median WTP (yen)	5,938 [4,429-7,958]	2,963 [1,711-5,133]
Mean WTP (yen)	14,611 [11,291-17,930]	8,339 [6,266-10,411]

Note. Numbers in the parentheses and the brackets are t-value and 95% confidence interval. One dollar was 93 yen in basic rate of 1995.

Table 3 indicates the estimated coefficient and point estimates of WTP for two formats, when cumulative distribution function is Weibull. The CDF for the Weibull is

$$F(y) = 1 - \exp\left[-(y / \alpha)^\beta\right].$$

The referendum questionnaire queries the WTP for improvement of the entirety of the river. The questionnaire of the private goods format asks the WTP for improvement of only part of the river. Reestimation with pooled data shows that coefficient of a dummy variable for the referendum format questionnaire is significant even at the 1% level. We conclude that there exists no scope insensitivity with this data set, assuming that the difference in payment vehicle causes no bias.

Kahneman's investigation of scope insensitivity has not yet been supported by thorough evidence. Weak sensitivity, not *insensitivity*, however, has an important implication for benefit transfer. As our results show, there exists no monotonical relationships between WTP and the size of the area of which quality is improved. It would be mistakes to multiply evaluated amounts per unit simply by the area to be newly evaluated. Researchers need not worry about this mistake when estimating the WTP for the conservation of famous and precious environmental assets, because the nonuse value is usually a unique characteristic of the resource itself and therefore not transferable. In that case, benefit transfer itself is invalid.

## 5. Considerations

### 5.1 Bias

We should give mention to a bias that payment vehicle might introduce to results. Downward bias can manifest both in the referendum format and in the private goods format. Some respondents posed the referendum format in the survey told interviewers that it is better to fund the clean-up of the river through eliminating inefficient governmental spending, rather than creating new source of tax revenue. Others within the private goods format responded that public sector should do the clean-up of the river, rather than collecting private donations through selling charcoal. Both factors can make the revealed WTP appear lower than the true WTP.

One might also say that public goods format can cause upward bias. Respondents might reluctantly answer yes even if the willingness to pay is below the suggested tax

amount, because of a feeling of responsibility to pay the assigned amount. There can be two explanations for this behavior. The first does not interpret this behavior as bias at all. It rather regards the choice as reflecting maximum WTP, because the respondent could afford to pay the amount anyway. On the one hand, respondents might not fully recognize optional situation of the questionnaire, and take it for granted that the imposition of the tax is compulsory. This possibility is critical, so this behavior cannot be taken as a useful expression of the respondent's preference. The situation is likely when respondents have never encountered a situation where they have a choice on the purchase of public goods. The examination of how well respondents recognized the setting remains a matter for further investigation.

## **5.2 Private goods vs. referenda**

Yamamoto and Oka (1994) used private goods (hypothetical filter) format to estimate the willingness to pay for reducing the cancer risk of drinking water. We followed this conception in one format of our survey.

There obviously exist merits and demerits of both the private goods and referendum formats. Private goods format can strengthen the avoidance of strategic bias, while heavily limiting the field of application of the CV. Referendum format broadens this field of application, but may cause higher "don't know" responses and upward bias. It seems to be, however, that this demerit of the private goods format is too severe to utilize it practically. The demerit of using the referendum format, if it exists, is not as severe.

## **5.3 Implication for the policy**

Amounts elicited by environmental valuation techniques have little significance if they are not used in policy. As noted in the introduction, institutions that require monetary valuation accelerated the development of evaluation techniques in the United States. In this section we consider how the WTP amounts for the Shimanto river can be used for policy.

Our analysis revealed that people of large cities such as Tokyo and Kyoto have considerable amount of WTP for preservation of a river, even one that runs far away from their environs. Though this fact does not decide the amount of allocation of the cost for water improvement, it does suggest a basis for demanding cost from residents in a distant place. For example, the public trust fund is one kind of system that collects

money necessary for conservation in this scenario.

In Japan, decision-making on local environmental resources within one prefecture tend to focus only on direct use value. This often results in excessive development of natural assets for sightseeing and tourism. However, it is also necessary to establish an institution that can collect some part of the WTP which urban residents possess, even if they were never to visit the sites.

Funds for preservation of forests surrounding water sources are a Japanese institution that aim to maintain environmental resources through cost allocation based on benefit principle. Funds are collected by contributions from municipalities located downstream of the river basin, and provide support for forest land upstream. Funding in the Yahagi river of Aichi prefecture is one such case.

On the other hand, the idea of a "suigen-zei" (tax for preservation of water sources) and a "sinrinkoufu-zei" (tax allocated to local governments based on forest area) are plans for such an institution at the national level<sup>2</sup>. Though these national level plans can collect the cost from broader region, they encounter resistance by non-beneficiaries. That is, the extent of the market for non-use value is difficult to decide. To entice distant residents to provide for preservation of local environmental assets, an appeal which emphasizes the attractiveness of the resources, as well as an institution that can collect WTP directly from beneficiaries, are both necessary. Assistance by national government for the creation of direct contribution schemes would help preservation of local natural resources and improve public welfare.

## 6. Conclusion

The study considered the applicability of the contingent valuation method. Our findings can be summarized as follows.

1. The "don't know" rate of referendum format may be higher than that of private goods format. This can be attributed to the fact that Japanese people are not accustomed participating in referenda on specific issues. However, we have indication that the situation may be changing to that which the referendum is an accepted form for

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<sup>2</sup> One purpose of these plans is to ensure the source of revenue for the lumber industry. Numbers of workers in this industry have been decreasing because of cheap imported timber and underpopulation in local areas. The plan of "Suigen-zei", adding some amount to water fees was planned mainly by the Forest Agency of Japan in 1985 - 86. Its establishment did not materialize because of powerful objections by economic organizations and other government agencies. The idea of "Sinrinkoufu-zei" is to include the forest area size as a basis of allocating national tax revenue to local municipalities. As of 1993, one-hundred and thirty municipalities were demanding its implementation.

- ascertaining the will of residents.
2. Assuming that difference in payment vehicle causes no bias, scope insensitivity does not exist with this data set. However, weak sensitivity (not insensitivity), has important implication for benefit transfer: it would be a mistake to multiply evaluated amounts per unit simply by the area to be newly evaluated, because there is no monotonical relationships between WTP and the size of the area of which quality is improved.
  3. Though there are merits and demerits of private goods and referendum format, but the referendum format seems to be the better of the two. Private goods format heavily limits the field of application of the CV.
  4. To actualize the consciousness of residents of urban centers for conservation of local environmental assets, it is essential to establish the institution that can collect the cost for conservation directly from beneficiaries.

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