

**Forest Policy and Economics Working Paper #1801, Natural Resource Economics,
Kyoto University.**

京都大学森林経済政策学ワーキングペーパー#1801

**The effect of payment units on the willingness to pay in a contingent
valuation survey**

Masaya Fujino ^a and Koichi Kuriyama ^b

*^a Masaya Fujino. Division of Human Environmental Science, Mount Fuji Research
Institute Yamanashi Prefectural Government, 5597-1, Kenmarubi, Kamiyoshida,
Fujiyoshida, Yamanashi, 403-0005, Japan. E-mail address: fujinoforest@gmail.com.*

*^b Koichi Kuriyama. Graduate School of Agriculture, Kyoto University, Kitashirakawa-
Oiwakecho, Sakyo-ku, Kyoto 606-8502, Japan.*

August, 2018

The effect of payment units on the willingness to pay in a contingent valuation survey

This study investigates whether the willingness to pay (WTP) for the provision of environmental goods depends on the different payment units utilized in contingent valuation surveys. We consider forest conservation in the Shiga prefecture in Japan as the evaluation target and set up a contingent valuation survey based on three different questions, which depend on the payment unit assumed (household, individual, or “strictly” individual unit). The results show no systematic difference in the WTP between the household and individual payment unit, while a significant difference exists between the individual and “strictly” individual unit. Therefore, the individual WTP might be overestimated unless the individual payment unit is explicitly compared with the household payment.

Keywords: contingent valuation, willingness to pay, payment unit, household, individual, Japan

JEL classification codes: C23, C51, Q51, Q57

1. Introduction

The research based on contingent valuation (CV) is thought to suffer from several biases that may originate from the irrelevance of the questionnaire (Mitchell and Carson 1989). For instance, the starting point bias is present when a value introduced by the proposed scenario may influence the respondent’s willingness to pay (WTP) for some good or service. If we were to simply compare the actual WTP with the estimated WTP, the impact of the bias would be small. However, when it comes to policy evaluation, the environmental value is calculated by multiplying the WTP with the number of individuals or the number of households; hence, the impact of the bias is magnified.

This study focuses on the payment unit defined from respondents in CV surveys. Many studies address respondents’ answers regarding their WTP as a household (e.g., Carson et al. 1992; Wei et al. 2007; Giannakopoulou et al. 2017), while others focus on

individuals (e.g., Cooper 1993; Wang and Zhang 2009; Voltaire et al. 2017). The differences between these two payment units, as well as the consequences of choosing one instead of the other, have not yet been systematically addressed in the literature. This study uses survey data to investigate whether different definitions of the payment unit imply systematic differences in the level of WTP for a good or service.

2. Payment unit definition

In terms of welfare economics, both “household” and “individual” are commonly used as payment units; hence, we cannot judge *ex-ante* which unit is more appropriate based on economic theory. On the other hand, Arrow et al. (1993, 48) argue that “a CV survey is to represent a natural population, such as all adults in the United States, or those in a single urban area or a state.” Carson (2000, 1416) refers to the payment unit as follows: “with respect to the unit of observation, the household is generally more appropriate if a payment vehicle like higher taxes or utility bills is used; while the converse is true of payments that take the form of entrance fees.” Johnston et al. (2017, 352) claim that individual versus household payments should be chosen based on the valuation context and pretested without specific criteria.

One of the disadvantages of using individual units is that an individual payment might refer to an adult person but also to a child with no ability to pay. The use of household units can help avoid this problem.

3. Methodology

3.1. Survey design and implementation

To investigate the differences in the WTP due to different payment units in CV surveys, we considered forest conservation in the Shiga prefecture in Japan as the evaluation

target. Among the possible elicitation methods, we opted for the double-bounded dichotomous choice. We prepared a general explanatory text and three alternative questions depending on the payment unit considered. The explanatory text is provided below.

The Shiga prefectural government carries out many projects (e.g., thinning) to fully exploit the multiple functions of the forests in the prefecture. Forests on which projects have been continuously implemented will be well managed. However, if the projects stop, the forests will be devastated, and their multiple functions will be affected. A hypothetical scenario will be depicted, and questions will be asked.

Suppose, for example, that the Shiga prefectural government is about to end all the projects related to forests and starting a new project to keep the forests well managed. To this end, the Shiga prefectural government will collect your contribution, and this money will only be used for forest conservation activities within the prefecture. Please notice that, when you contribute, your available income will be reduced by that amount.

Question A:

Would you be willing to pay T1 JPY per household annually for 10 years only?

Question B:

Would you be willing to pay T1 JPY per individual annually for 10 years only?

Question C:

Would you be willing to pay T1 JPY per individual (corresponding to T2 JPY annual burden for the household) annually for 10 years only?

T1 are initial bids (Table 1). Respondents could answer YES or NO to the question randomly assigned to them. Respondents are presented with the follow-up

question according to the answer to the first question. At the end of the CV survey, we asked all respondents to justify their answers.

More in detail, questions A, B, and C ask about the WTP of the household, the individual, and the “strictly” individual unit, respectively. The difference between questions A and B is in the payment unit they refer to (household or individual, respectively). The difference between questions B and C, instead, is whether or not respondents are made aware of the burden for the household. After questions A and B, before proceeding to question C, the number of household members was asked. As a result, T2 could be calculated by multiplying T1 with the household size.

3.2. Sample

In September 2016, a sample of 2,158 respondents was built from a web-based panel. We designed a survey that was carried out by a Japanese marketing firm, Nikkei Research Inc., under our direction.

We excluded 495 protest respondents (who do not state their real preference because they are dissatisfied with the scenario or payment method), 107 warm glow effect respondents (who are satisfied with paying for environmental improvement itself), and 12 quick respondents (their answer time was under one second). Therefore, we utilized data from 1,544 respondents. Table 2 compares the average socioeconomic characteristics of the three samples. The variance analysis indicates no significant difference in the socioeconomic characteristics of the different samples, both for all respondents and for valid respondents (at the 10% significance level); however, a significant difference was found for excluded respondents (at the 10% significance level, as assessed by the chi-square test). The protest respondents are less for question A and more for question C. In the survey, six types of responses were regarded as protest responses, but no difference was found for each payment unit at the 10% significance

level, as assessed by the chi-square test (Table 3). Therefore, there is a possibility that the strictly individual payment unit causes protest response.

4. Results

Table 4 reports the estimation results. We group the respondents by the question they answered and test the difference in the coefficients through a likelihood ratio test. We cannot reject the hypothesis that question A is different from question B at any reasonable significance level (the log likelihood ratio is 0.71). On the other hand, we reject the hypothesis that question A is different from question C (the log likelihood ratio is 4.75), while question B is found to be significantly different from question C (the log likelihood ratio is 4.80) at the 1% significance level. The results confirm that asking questions in terms of household or “strictly” individual units implies a significant and systematic difference in the response.

The median WTP is 2,261 JPY, while the mean WTP is 3,443 JPY per household or individual unit (questions A and B). For “strictly” individual units, the median WTP is 1,924 JPY, while the mean WTP is 3,073 JPY (question C). The household median WTP for question C is 5,387 JPY ($1,924 \text{ JPY} * 2.80$), more than twice the median WTP of question A and B. The results confirm that the WTP is lower in the questionnaire that refers to “strictly” individual units than in those referring to individual and household units.

5. Discussion

With respect to the same individual unit, there seems to be a difference between cases in which the household is explicitly mentioned and cases in which it is not. More in detail,

we express the three questions in terms of utility function U , as follows:

$$\text{Question A: } U(Q_0, MH) = U(Q_1, MH - WTP_A), \quad (1)$$

$$\text{Question B: } U(Q_0, MI) = U(Q_1, MI - WTP_B), \quad (2)$$

$$\text{Question C: } U(Q_0, MH) = U(Q_1, MH - WTP_C * N), \quad (3)$$

where the quality of the environmental good (i.e., a well-managed forest) improves from Q_0 to Q_1 after the payment. Moreover, MH is the household income, MI is the individual income, and N is the household size. The utility functions show that, in contrast with the estimation results, WTP_A is different from WTP_B if MH is different from MI , while WTP_A and $WTP_C * N$ are equal.

We assumed that, when we do not put emphasis on the household, only the amount paid by the respondent is consciously taken into account, while the payment of the whole household is not considered. When the “strictly” individual WTP is accurate, the individual WTP may be overestimated and the household WTP may be underestimated. Moreover, there is a possibility that the respondents of question A had in mind the individual unit, and respondents of question B did not consider that the burden increase as the number of households rises. A possible solution would be to ask question A after question B and, then, verify the difference in terms of WTP.

6. Conclusion

This study focuses on the payment unit or compensation for respondents to a CV survey on environmental goods’ provision and uses survey data to measure the difference in the WTP when different payment units are employed. To this end, we considered forest conservation in the Shiga prefecture in Japan as the evaluation target. By employing a double-bounded dichotomous choice as the elicitation method, we prepared a common explanatory text followed by one of three alternative questions depending on the

payment unit (household, individual, and “strictly” individual unit). The results indicate no difference between the household and individual WTP, while the latter is found to be significantly different from the WTP for the “strictly” individual unit. This result might lead to the overestimation of the individual WTP, unless both the individual and household amounts are explicitly mentioned in the question.

Acknowledgments

The authors appreciate the help of Mr. Kengo Iwata, who cooperated in the project by preparing the questionnaire. The authors gratefully acknowledge the financial support from the Shiga prefecture.

References

- Arrow, K., R. Solow, P.R. Portney, E.E. Leamer, R. Radner, and H. Schuman. 1993. “Report of the NOAA panel on contingent valuation.” *Federal register* 58(10): 4601-4614.
- Carson, R.T. 2000. “Contingent valuation: a user's guide.” *Environmental Science & Technology* 34 (8): 1413–1418. (DOI: 10.1021/es990728j)
- Carson, R.T., R.C. Mitchell, W.M. Hanemann, R.J. Kopp, S. Presser, and P.A. Ruud. 1992. “A contingent valuation study of lost passive use values resulting from the Exxon Valdez oil spill.” Report to the Attorney General of the State of Alaska.
- Cooper, J.C. 1993. “Optimal bid selection for dichotomous choice contingent valuation surveys.” *Journal of Environmental Economics and Management* 24(1): 25-40. (DOI: <https://doi.org/10.1006/jeem.1993.1002>)
- Giannakopoulou, S., E. Xypolitakou, D. Damigos, and D. Kaliampakos. 2017. “How visitors value traditional built environment? Evidence from a contingent

- valuation survey". *Journal of Cultural Heritage* 24: 157-164. (DOI: <https://doi.org/10.1016/j.culher.2016.11.004>)
- Johnston, R.J., K.J. Boyle, W. Adamowicz, J. Bennett, R. Brouwer, T.A. Cameron, and R. Tourangeau. 2017. "Contemporary guidance for stated preference studies." *Journal of the Association of Environmental and Resource Economists* 4(2): 319-405. (DOI: <https://doi.org/10.1086/691697>)
- Mitchell, R.C. and R.T. Carson. 1989. "Using surveys to value public goods: the contingent valuation method." Resources for the Future, Washington.
- Voltaire, L., H.P.P. Donfouet, C. Pirrone, and A. Larzillière. 2017. "Respondent Uncertainty and Ordering Effect on Willingness to Pay for Salt Marsh Conservation in the Brest Roadstead (France)." *Ecological Economics* 137: 47-55. (DOI 10.1016/j.ecolecon.2017.02.029)
- Wang, Y., and Y.S. Zhang. 2009. "Air quality assessment by contingent valuation in Ji'nan, China." *Journal of Environmental Management* 90(2): 1022-1029. (DOI: <https://doi.org/10.1016/j.jenvman.2008.03.011>)
- Wei, Y., B. Davidson, D. Chen, R. White, B. Li, and J. Zhang. 2007. "Can contingent valuation be used to measure the in situ value of groundwater on the North China Plain?." *Water resource management* 21(10): 1735-1749. (DOI: <https://doi.org/10.1007/s11269-006-9123-2>)

Table 1. Alternative bids for forest conservation

T1	TU	TL
500	1,000	250
1,000	2,000	500
2,000	5,000	1,000
5,000	10,000	2,000

Note: T1 is the initial bid; TU is the second bid if the response to the first bid was “YES”; TL is the second bid if the response to first bid was “NO”

Table 2. Comparison of the average socioeconomic characteristics of the three samples

	Question A (household)	Question B (individual)	Question C ("strictly" individual)
All respondents			
Age (years)	47.4	46.8	46.6
Household size	2.71	2.70	2.80
Household Income (1,000 JPY)	5,927	6,035	6,125
Valid respondents			
Age (years)	47.5	47.9	47.6
Household size	2.72	2.65	2.80
Household Income (1,000 JPY)	6,134	5,976	6,328
N of all respondents	728	725	705
N of protest respondents	141***	174	181**
N of warm glow effect respondents	34	43	30
N of quick respondents	3	3	5
N of valid respondents	550***	505	489

Note: ***, ** denote significance at the 1% and 5% level, respectively, as indicated by the residual analysis.

Table 3. Reasons of protest respondents

	Question A (household)	Question B (individual)	Question C ("strictly" individual)
Do not want to conserve the forests	2	4	6
Forest owners should bear the cost burden	24	33	15
Local residents should bear the cost burden	11	10	18
Do not want to bear the cost burden	59	77	73
Do not think recover the forests' function	18	16	25
Other	27	34	44
Total	141	174	181

Table 4. Estimation results

	A			B			C		
	Estimate	t-value		Estimate	t-value		Estimate	t-value	
Constant	10.61	21.32	***	11.22	20.74	***	10.66	19.55	***
Ln (Bid)	-1.37	-21.14	***	-1.45	-20.68	***	-1.41	-19.48	***
N	550			505			489		
LL	-764			-700			-666		

Note that *** denotes significant at the 1% level.