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Contingent Valuation Study

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ABSTRACT

A NOAA panel recommended that “no-answer” options be explicitly included in referendum-style contingent valuation (CV) surveys. However, excluding the resulting no-vote (NV) responses would mean not only losing the choice preference information of these respondents, it could also cause sample selection bias. This would be true if NV respondents’ preferences differed from other respondents in the sample. This paper analyzes the incentive effects of NV options in double-bounded CV. If initial bids affect follow-up NV responses, there is a systematic difference between initial NV responses and follow-up NV responses. To analyze these effects we use a bivariate ordered probit model; this combines an ordered probit and a bivariate probit model.

Our empirical analysis uses data from a Yakusima World Heritage Site CV survey. Following the NOAA panel, we consider many CV survey design issues. These include conservative survey design, the double-bounded referendum elicitation method, the willingness to pay format, door-to-door in-person interviews, scope issues, and NV options. After extensive pilot surveys, a final CV survey was administered nationally in July 1997, resulting in 821 complete responses. The double-bounded data is analyzed using a bivariate ordered probit model. The empirical results demonstrate a strategic downward bias of 322 yen for the “strong scenario” when excluding the NV option, and 1,763 yen when the NV option is included. The NV option may strengthen strategic downward bias in double-bounded CV surveys.

1. INTRODUCTION

National Oceanic and Atmospheric Administration (NOAA) panel's report on contingent valuation (CV) surveys stated that "The valuation question should be posed as a vote on a referendum" and "A 'no-answer' option should be explicitly allowed in addition to the 'yes' and 'no' vote options on the main valuation (referendum) question" (Arrow et al., 1993). However, explicitly offering respondents a "not sure/ don't know/ would-not-vote" (NV) option in CV surveys may cause a loss of preference information from respondents who choose the NV option. A split-sample experiment by Carson et al. (1995) showed that the percentage of the sample selecting the NV option increased from 6.7% to 17.7% when the NV option was offered. Treating all NV responses as "no" votes, the authors found that offering the NV option does not change the estimate of willingness-to-pay (WTP). Dropping the respondents who choose NV may not only mean losing their choice preference information, it may also cause sample selection bias if NV respondents' preferences differ from the rest of the sample.

Svento (1993), Svento and Mantymaa (1994), and Wu (1997) provide another utility-theory-based interpretation of the NV option using an ordered probit model. However, their model can only be applied to a single-bounded approach, whereas many CV studies use the double-bounded elicitation method proposed by Hanemann (1985), Carson (1985), and Carson, Hanemann, and Mitchell (1986). In double-bounded CV, follow-up bids are dependent upon responses to initial bids: when the initial response is "yes", follow-up bids are typically greater than initial bids; when the initial response is "no", follow-up bids are less. Hanemann, Loomis, and Kanninen (1991) demonstrated an improvement in the statistical efficiency of estimates obtained by using the double-bounded approach.

Recent CV studies have shown that initial bids affect follow-up responses in double-bounded models. Cameron and Quiggin (1994) introduced a bivariate probit model that includes a correlation between the initial and follow-up response. Previous research into the effects on follow-up responses has examined "yes-saying" (Kanninen 1995), "anchoring" (Herriges and Shogren 1996), "ambivalence" (Opaluch and Segerson 1989; Ready, Whitehead, and Blomquist 1995), "framing" (Deshazo 1996), and "incentive effects" (Alberini et al. 1997).

This paper analyzes the incentive effects of NV options in double-bounded CV. If the initial bid affects the follow-up NV response, then there is a systematic difference between the initial NV response and the follow-up NV response. To analyze these effects,

we use a bivariate ordered probit model; this combines an ordered probit (Svento) and a bivariate probit model (Cameron and Quiggin).

This paper is organized as follows: Section 2 describes our model of initial and follow-up ‘NV’ responses. Responses using a double-bounded CV with an NV option are analyzed using both an ordered probit and a bivariate ordered probit model. Bivariate ordered probit models allow estimation of structural shifts in the WTP function with the NV option. Section 3 presents an empirical study using data from the Yakusima World Heritage Site. Following the NOAA panel, we consider many CV survey design issues such as conservative survey design, the double-bounded referendum elicitation method, the willingness to pay format, door-to-door in-person interviews, scope issues, and use of the NV option. Our results are described in section 4. Finally, section 5 provides concluding comments.

2. MODEL

Figure 1 presents bids and responses from double-bounded CV with a NV option. T_1 is the initial bid. Respondents choose one of ‘yes’, ‘no’, or ‘NV’. If the initial response is ‘yes’, the follow-up bid is the upper bid (T_U). If the initial response is ‘no’, the follow-up bid is the lower bid (T_L). There are seven response combinations available in double-bounded CV with a NV option: Y-Y, Y-NV, Y-N, NV, N-Y, N-NV, and N-N.

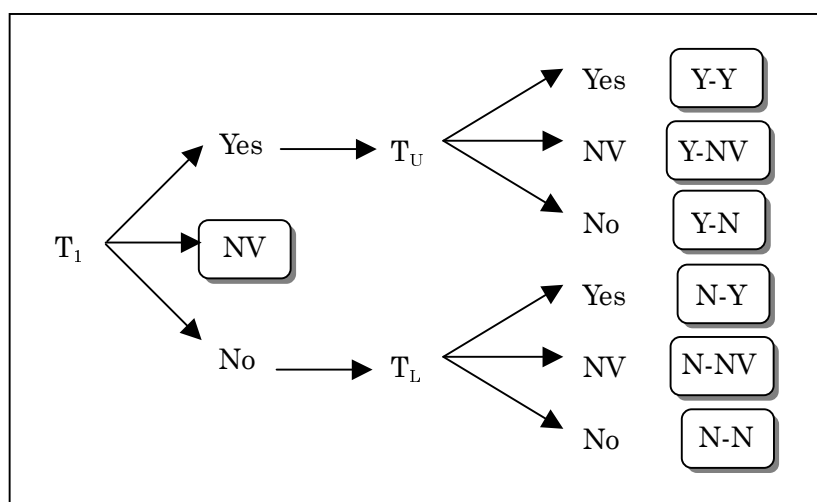


Figure 1. Bids and responses, double-bounded CV with a NV option

Single-bounded models

Using a single-bounded model, Svento (1993) assumed that if the bid is close to the willingness-to-pay (WTP), the individual is indifferent between answering ‘yes’ or ‘no’. Let WTP be expressed as $\ln WTP_{li} = \mathbf{x}_i \beta + \varepsilon_{li}$ where \mathbf{x}_i is a vector of regressors and ε_{li} is an error term with mean zero and variance σ^2 . Respondent i answers ‘yes’ when $\ln(T_{li} - \alpha_1) \leq \ln(WTP_{li})$, where α_1 is a threshold parameter. A ‘no’ occurs when $\ln(WTP_{li}) < \ln(T_{li} + \alpha_1)$; and ‘not sure/ don’t know/ would-not-vote’ is selected when the WTP falls within the indifferent zone; that is $\ln(T_{li} - \alpha_1) \leq \ln(WTP_{li}) < \ln(T_{li} + \alpha_1)$. Assuming normally distributed error terms the WTP can be estimated using an ordered probit model. The probabilities of each response are therefore:

$$\begin{aligned}
 \pi_i^Y &= \Pr[\ln(T_{li} + \alpha_1) \leq \ln WTP_{li}] \\
 &= \Pr\left[\frac{\ln(T_{li} + \alpha_1) - \mathbf{x}_i \beta}{\sigma} \leq \frac{\varepsilon_{li}}{\sigma}\right] \\
 &= 1 - \Phi\left(\frac{\ln(T_{li} + \alpha_1) - \mathbf{x}_i \beta}{\sigma}\right)
 \end{aligned} \tag{1}$$

$$\begin{aligned}
 \pi_i^N &= \Pr[\ln WTP_{li} < \ln(T_{li} - \alpha_1)] \\
 &= \Pr\left[\frac{\varepsilon_{li}}{\sigma} < \frac{\ln(T_{li} - \alpha_1) + \mathbf{x}_i \beta}{\sigma}\right] \\
 &= \Phi\left(\frac{\ln(T_{li} - \alpha_1) - \mathbf{x}_i \beta}{\sigma}\right)
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 \pi_i^{NV} &= \Pr[\ln(T_{li} - \alpha_1) \leq \ln WTP_{li} < \ln(T_{li} + \alpha_1)] \\
 &= \Pr\left[\frac{\ln(T_{li} - \alpha_1) - \mathbf{x}_i \beta}{\sigma} \leq \varepsilon_{li} < \frac{\ln(T_{li} + \alpha_1) - \mathbf{x}_i \beta}{\sigma}\right] \\
 &= \Phi\left(\frac{\ln(T_{li} + \alpha_1) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{li} - \alpha_1) - \mathbf{x}_i \beta}{\sigma}\right)
 \end{aligned} \tag{3}$$

The log likelihood function of the single-bounded model is:

$$\ln L_{SB} = \sum_{i=1}^n d_i^Y \ln \pi_i^Y + d_i^N \ln \pi_i^N + d_i^{NV} \ln \pi_i^{NV} \quad [4]$$

where d_i^Y , d_i^N , and d_i^{NV} are dummy variables, defined such that $d_i^Y = 1$ if the response is yes and $d_i^Y = 0$ otherwise; $d_i^N = 1$ if the response is no and $d_i^N = 0$ otherwise; and $d_i^{NV} = 1$ if the response is NV and $d_i^{NV} = 0$ otherwise.

Double-bounded models (ordered probit)

If the initial bid does not affect the follow-up response ($WTP_{1i} = WTP_{2i}$), Svento's model can easily be expanded to a double-bounded CV. If the follow-up bid is close to the WTP, the follow-up response is NV. Figure 2 shows the WTP distribution function and responses when $WTP_{1i} = WTP_{2i}$. The respondent's answer is therefore:

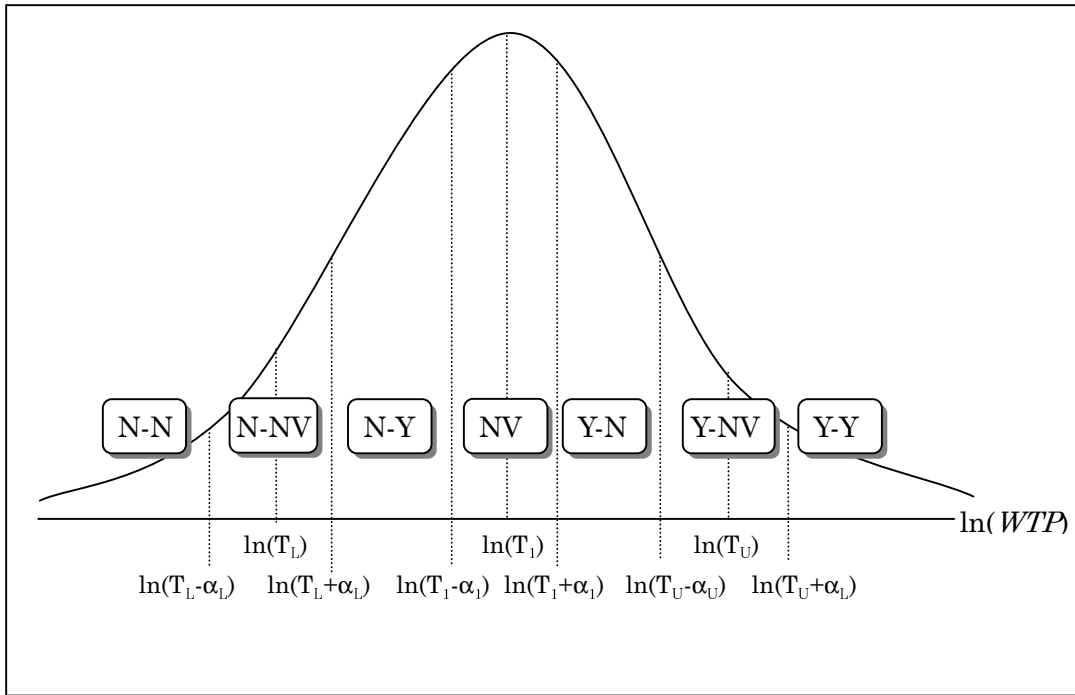


Figure 2. WTP distribution and responses

- 'yes-yes' when $\ln(T_{Ui} + \alpha_{Ui}) \leq \ln(WTP_{1i})$
- 'yes-NV' when $\ln(T_{Ui} - \alpha_{Ui}) \leq \ln(WTP_{1i}) < \ln(T_{Ui} + \alpha_{Ui})$
- 'yes-no' when $\ln(T_{Li} + \alpha_{Li}) \leq \ln(WTP_{1i}) < \ln(T_{Ui} - \alpha_{Ui})$
- 'NV' when $\ln(T_{Li} - \alpha_{Li}) \leq \ln(WTP_{1i}) < \ln(T_{Li} + \alpha_{Li})$
- 'no-yes' when $\ln(T_{Li} + \alpha_{Li}) \leq \ln(WTP_{1i}) < \ln(T_{Li} - \alpha_{Li})$

‘no-NV’ when $\ln(T_{Li} - \alpha_{Li}) \leq \ln(WTP_{li}) < \ln(T_{Li} + \alpha_{Li})$

‘no-no’ when $\ln(WTP_{li}) < \ln(T_{Li} - \alpha_{Li})$

where α_1 , α_U , and α_L are threshold parameters. Assuming normally distributed error terms, the WTP can be estimated by an ordered probit model as in the single-bounded case. The probabilities of each response are:

$$\begin{aligned}\pi_i^{Y-Y} &= \Pr[\ln(T_{Ui} + \alpha_{Ui}) \leq \ln WTP_{li}] \\ &= 1 - \Phi\left(\frac{\ln(T_{Ui} + \alpha_{Ui}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [5]$$

$$\begin{aligned}\pi_i^{Y-NV} &= \Pr[\ln(T_{Ui} - \alpha_{Ui}) \leq \ln WTP_{li} < \ln(T_{Ui} + \alpha_{Ui})] \\ &= \Phi\left(\frac{\ln(T_{Ui} + \alpha_{Ui}) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{Ui} - \alpha_{Ui}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [6]$$

$$\begin{aligned}\pi_i^{Y-N} &= \Pr[\ln(T_{li} + \alpha_{li}) \leq \ln WTP_{li} < \ln(T_{li} - \alpha_{li})] \\ &= \Phi\left(\frac{\ln(T_{li} - \alpha_{li}) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{li} + \alpha_{li}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [7]$$

$$\begin{aligned}\pi_i^{NV} &= \Pr[\ln(T_{li} - \alpha_{li}) \leq \ln WTP_{li} < \ln(T_{li} + \alpha_{li})] \\ &= \Phi\left(\frac{\ln(T_{li} + \alpha_{li}) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{li} - \alpha_{li}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [8]$$

$$\begin{aligned}\pi_i^{N-Y} &= \Pr[\ln(T_{Li} + \alpha_{Li}) \leq \ln WTP_{li} < \ln(T_{Li} - \alpha_{Li})] \\ &= \Phi\left(\frac{\ln(T_{Li} - \alpha_{Li}) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{Li} + \alpha_{Li}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [9]$$

$$\begin{aligned}\pi_i^{N-NV} &= \Pr[\ln(T_{Li} - \alpha_{Li}) \leq \ln WTP_{li} < \ln(T_{Li} + \alpha_{Li})] \\ &= \Phi\left(\frac{\ln(T_{Li} - \alpha_{Li}) - \mathbf{x}_i \beta}{\sigma}\right) - \Phi\left(\frac{\ln(T_{Li} + \alpha_{Li}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [10]$$

$$\begin{aligned}\pi_i^{N-N} &= \Pr[\ln WTP_{li} < \ln(T_{Li} - \alpha_{Li})] \\ &= \Phi\left(\frac{\ln(T_{Li} - \alpha_{Li}) - \mathbf{x}_i \beta}{\sigma}\right)\end{aligned}\quad [11]$$

The log likelihood function of the double-bounded model is:

$$\begin{aligned} \ln L_{DB} = & \sum_{i=1}^n d_i^{Y-Y} \ln \pi_i^{Y-Y} + d_i^{Y-NV} \ln \pi_i^{Y-NV} + d_i^{Y-N} \ln \pi_i^{Y-N} + d_i^{NV} \ln \pi_i^{NV} \\ & + d_i^{N-Y} \ln \pi_i^{N-Y} + d_i^{N-NV} \ln \pi_i^{N-NV} + d_i^{N-N} \ln \pi_i^{N-N} \end{aligned} \quad [12]$$

where d_i^{Y-Y} , d_i^{Y-NV} , d_i^{Y-N} , d_i^{NV} , d_i^{N-Y} , d_i^{N-NV} , and d_i^{N-N} are dummy variables defined such that $d_i^{Y-Y} = 1$ if the initial response is yes and follow up response is yes and $d_i^{Y-Y} = 0$ otherwise; others follow accordingly.

Random-effect models (bivariate ordered probit)

If the initial bid affects the follow-up response ($WTP_{1i} \neq WTP_{2i}$), double-bounded CV data can be interpreted as panel data with random-effects (Hsiao, 1986). Assume WTP can be written as:

$$\begin{aligned} \ln WTP_{1i} &= \mathbf{x}_i \boldsymbol{\beta} + \varepsilon_{1i} \\ \ln WTP_{2i} &= \mathbf{x}_i \boldsymbol{\beta} + \varepsilon_{2i} \end{aligned} \quad [13]$$

Assuming two bivariate normally distributed error terms, Cameron and Quiggin (1994) estimate WTP using a bivariate probit model. Although this allows for correlation between two error terms, it cannot be used to analyze the effects of a NV option. To analyze NV option effects, we use a bivariate ordered probit model; this combines an ordered probit (Svento) and a bivariate probit (Cameron and Quiggin) model.

Assume two bivariate normally distributed error terms with mean zero and variance σ^2 . The probabilities of each response are:

$$\begin{aligned} \pi_i^{Y-Y} &= \Pr[\ln(T_1 + \alpha_1) \leq \ln WTP_1, \ln(T_U + \alpha_U) \leq \ln WTP_2] \\ &= \int_{(T_1 + \alpha_1 - \mu)/\sigma}^{\infty} \int_{(T_U + \alpha_U - \mu)/\sigma}^{\infty} g(z_1, z_2, \rho) dz_2 dz_1 \\ &= 1 - \Phi\left(\frac{\ln(T_1 + \alpha_1) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(T_U + \alpha_U) - \mu}{\sigma}\right) \\ &\quad + \Phi\left(\frac{\ln(T_U + \alpha_U) - \mu}{\sigma}, \frac{\ln(T_1 + \alpha_1) - \mu}{\sigma}, \rho\right) \end{aligned} \quad [14]$$

$$\begin{aligned}
\pi_i^{Y-V} &= \Pr[\ln(T_1 + \alpha_1) \leq \ln WTP_1, \ln(T_U - \alpha_U) \leq \ln WTP_2 < \ln(T_U + \alpha_U)] \\
&= \int_{(T_1 + \alpha_1 - \mu)/\sigma}^{\infty} \int_{(T_U - \alpha_U - \mu)/\sigma}^{(T_U + \alpha_U - \mu)/\sigma} g(z_1, z_2, \rho) dz_2 dz_1 \\
&= \Phi\left(\frac{\ln(T_U + \alpha_U) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(T_U + \alpha_U) - \mu}{\sigma}, \frac{\ln(T_1 + \alpha_1) - \mu}{\sigma}, \rho\right) \\
&\quad - \Phi\left(\frac{\ln(T_U - \alpha_U) - \mu}{\sigma}\right) + \Phi\left(\frac{\ln(T_U + \alpha_U) - \mu}{\sigma}, \frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}, \rho\right) \quad [15]
\end{aligned}$$

$$\begin{aligned}
\pi_i^{Y-N} &= \Pr[\ln(T_1 + \alpha_1) \leq \ln WTP_1, -\infty \leq \ln WTP_2 < \ln(T_U - \alpha_U)] \\
&= \int_{(T_1 + \alpha_1 - \mu)/\sigma}^{\infty} \int_{-\infty}^{(T_U - \alpha_U - \mu)/\sigma} g(z_1, z_2, \rho) dz_2 dz_1 \quad [16] \\
&= \Phi\left(\frac{\ln(T_U - \alpha_U) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(T_U - \alpha_U) - \mu}{\sigma}, \frac{\ln(T_1 + \alpha_1) - \mu}{\sigma}, \rho\right)
\end{aligned}$$

$$\begin{aligned}
\pi_i^{NV} &= \Pr[\ln(T_1 - \alpha_1) \leq \ln WTP_1 < \ln(T_1 + \alpha_1)] \\
&= \Phi\left(\frac{\ln(T_1 + \alpha_1) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}\right) \quad [17]
\end{aligned}$$

$$\begin{aligned}
\pi_i^{N-Y} &= \Pr[\ln WTP_1 < \ln(T_1 - \alpha_1), \ln(T_L + \alpha_L) \leq \ln WTP_2] \\
&= \int_{-\infty}^{(T_1 - \alpha_1 - \mu)/\sigma} \int_{(T_L + \alpha_L - \mu)/\sigma}^{\infty} g(z_1, z_2, \rho) dz_2 dz_1 \quad [18] \\
&= \Phi\left(\frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(T_L + \alpha_L) - \mu}{\sigma}, \frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}, \rho\right)
\end{aligned}$$

$$\begin{aligned}
\pi_i^{N-NV} &= \Pr[\ln WTP_1 < \ln(T_1 - \alpha_1), \ln(T_L - \alpha_L) \leq \ln WTP_2 < \ln(T_L + \alpha_L)] \\
&= \int_{-\infty}^{(T_1 - \alpha_1 - \mu)/\sigma} \int_{(T_L - \alpha_L - \mu)/\sigma}^{(T_L + \alpha_L - \mu)/\sigma} g(z_1, z_2, \rho) dz_2 dz_1 \\
&= \Phi\left(\frac{\ln(T_L + \alpha_L) - \mu}{\sigma}, \frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}, \rho\right) \\
&\quad - \Phi\left(\frac{\ln(T_L - \alpha_L) - \mu}{\sigma}, \frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}, \rho\right) \quad [19]
\end{aligned}$$

$$\begin{aligned}
\pi_i^{N-N} &= \Pr[\ln WTP_1 < \ln(T_1 - \alpha_1), \ln WTP_2 < \ln(T_L - \alpha_L)] \\
&= \int_{-\infty}^{(T_1 - \alpha_1 - \mu)/\sigma} \int_{-\infty}^{(T_L - \alpha_L - \mu)/\sigma} g(z_1, z_2, \rho) dz_2 dz_1 \\
&= \Phi\left(\frac{\ln(T_L - \alpha_L) - \mu}{\sigma}, \frac{\ln(T_1 - \alpha_1) - \mu}{\sigma}, \rho\right)
\end{aligned}
\tag{20}$$

where $\mu = \mathbf{x}_i\boldsymbol{\beta}$, $g(-, -, \rho)$ is the bivariate normal density function, $\Phi(-, -, \rho)$ the bivariate normal cumulative distribution function, and ρ the correlation parameter.

Structural Shift in WTP

Alberini et al. (1997) analyzed the structural shift in WTP. If respondents assume the first bid to be the average program cost, they may feel additional payment of the second higher bid results in government waste. In this case there is structural shift in WTP caused by incentive effects. Assume the WTPs are:

$$\begin{aligned}
\ln WTP_{1i} &= \mathbf{x}_i\boldsymbol{\beta} + \varepsilon_{1i} \\
\ln WTP_{2i} &= \mathbf{x}_i\boldsymbol{\beta} + \boldsymbol{\delta} + \varepsilon_{2i}
\end{aligned}
\tag{21}$$

where $\boldsymbol{\delta}$ represents structural shift.

3. EMPIRICAL STUDY: Environmental Valuation of Yakusima World Heritage Site

The data comes from a contingent valuation survey of Yakusima World Heritage Site. The area contains unique Yakusugi trees which are thousands of years old. It was added to the United Nations' World Heritage List in December 1993 because of its unique ecosystem and natural beauty. However, the resulting increase in recreational users of the site created a conflict between recreational use (use value) and preservation of the ecosystem (non-use value).

Following a NOAA panel recommendation, we considered many CV survey design issues, including conservative survey design, the double-bounded referendum elicitation method, the WTP format, door-to-door in-person interviews, scope issues, and the NV option. Two focus groups helped us to develop two CV scenarios: a "strong scenario", representing a management plan for total value (use value and non-use

value), and a “weak scenario” which considers only use value. The landscape, recreational use and ecological diversity of Yakusima Island, the environmental impact of recreational use, and the management plan were described. After describing in detail how to manage Yakusima, respondents were asked the payment question. The payment vehicle was a one-time voluntary payment to Yakusima World Heritage fund. The valuation question was as follows:

Q5e. Because we value your opinion whether to protect Yakusima, please tell us your own opinion. Your household must make a one-time payment of *** yen next year to protect the Yakusima environment under this management plan. Your payment will be used only for the protection of Yakusima. Note that your budget for commodities decreases upon payment to this fund. If the total cost to your household is a one-time payment of ***** yen next year, would you vote for this plan to protect Yakusima, or would you vote against it?**

- | | |
|--------------------|------------------|
| 1. FOR | Go to Q5b |
| 2. AGAINST | Go to Q5c |
| 8. NOT SURE | Go to Q5d |

The NV option (NOT SURE) was explicitly offered to respondents at both the initial and follow-up bid. First cost amounts were 1,000, 3,000, 6,000, and 15,000 yen. Follow-up costs were 3,000, 6,000, 15,000, and 40,000 yen if the first response was a ‘yes’, and 500, 1,000, 3,000, and 6,000 yen if the first response was a ‘no’.

After four pilot surveys, the final CV survey was administered in July 1997 throughout Japan; there were 821 complete responses (a response rate of 68.4%). The average interview time was 24 minutes. The valid sample of the double-bounded elicitation question with a NV response was 616¹. Table 1 shows the number of respondents in each category by offer bids. The number of respondents who chose the NV option in the first or second question was 183 (29.7%). Table 2 shows the description and mean value of selected variables. Further survey details appear in Forestry Agency (1997).

¹ 106 samples were dropped due to the use of a ballot box survey which resulted in first-bid-only responses. A further 88 samples were dropped because respondents misunderstood the scenario.

TABLE 1. Offered Bids by Response Type

	Y-Y	Y-N	N-Y	N-N	Y-NV	N-NV	NV	Total
1,000	26 (16.6%)	30 (19.1%)	3 (1.9%)	41 (26.1%)	27 (17.2%)	5 (3.2%)	25 (15.9%)	157 (100.0%)
3,000	16 (10.5%)	21 (13.7%)	15 (9.8%)	56 (36.6%)	18 (11.8%)	2 (1.3%)	25 (16.3%)	153 (100.0%)
6,000	9 (6.0%)	17 (11.4%)	10 (6.7%)	76 (51.0%)	12 (8.1%)	3 (2.0%)	22 (14.8%)	149 (100.0%)
15,000	3 (1.9%)	20 (12.7%)	7 (4.5%)	83 (52.9%)	10 (6.4%)	4 (2.5%)	30 (19.1%)	157 (100.0%)
Total	54 (8.8%)	88 (14.3%)	35 (5.7%)	256 (41.6%)	67 (10.9%)	14 (2.3%)	102 (16.6%)	616 (100.0%)

TABLE 2. Variable List

Variable Names	Description	Mean Value	Standard Deviation
Strong	1 = strong scenario; 0 = weak scenario	0.682	0.47
Protection	1 = respondent feels ecosystem of Yakusima can be protected by this scenario; 0 = otherwise	0.476	0.50
Importance	1 = respondent feels ecosystem of Yakusima is important; 0 = otherwise	0.866	0.34
Development	1 = respondent is interested in the assessment of the development project; 0 = otherwise	0.607	0.49
N_household	Number of people in respondent's household	3.748	1.59
N_income	Number of income-earners in respondent's household	1.977	1.01

4. RESULTS

We compared four models. Model 1 is a censored probit model that assumes the initial cost has no effect on the follow-up response ($WTP_{1i}=WTP_{2i}$); it drops NV samples who choose NV, Y-NV, or N-NV. Model 2 is a bivariate probit model with structural shift that assumes the first bid affects the follow-up response ($WTP_{1i} \neq WTP_{2i}$) and drops NV samples. Model 3 is an ordered probit model that assumes $WTP_{1i}=WTP_{2i}$ and includes NV samples. Model 4 is a bivariate ordered probit model with structural shift that assumes $WTP_{1i} \neq WTP_{2i}$ and includes NV samples.

Table 3 presents results estimated by maximizing the likelihood function.

Because a dummy variable of the strong scenario (Strong) is significant in all models, the scope insensitivity hypothesis is rejected. The dummy variable PROTECTION refers to respondents who feel the ecosystem of Yakusima can be protected by this scenario. IMPORTANT is a dummy variable for respondents who feel the ecosystem of Yakusima is important. As expected, these variables have a significant positive influence on a respondent's WTP in all models. DEVELOPMENT is the dummy variable for respondents who are interested in an assessment of the development projects (which include a dam and road construction). DEVELOPMENT also has a positive effect on respondents' WTP. N_HOUSEHOLD, the number of people in the respondent's household, carries a negative sign. This implies that respondents who live with many people in their household have a lower WTP. N_INCOME indicates the number of income-earners in the respondent's household; it positively influences the WTP of respondents.

TABLE 3. Estimated WTP Function

	Model 1	Model 2	Model 3	Model 4
Variable	Coefficient	Coefficient	Coefficient	Coefficient
Constant	-0.338 (-0.583)	-1.147 (-1.218)	1.674 (36.038)	1.080 (2.327)
σ	1.858 (14.278)	2.741 (6.027)	1.551 (35.903)	2.199 (13.267)
ρ		0.327 (3.842)		0.734 (14.506)
Strong	0.800 (3.100)	0.956 (2.828)	0.288 (6.233)	0.461 (2.177)
Protection	1.237 (5.329)	1.489 (4.404)	0.695 (6.053)	0.989 (4.918)
Importance	1.525 (3.729)	1.999 (3.414)	0.777 (10.968)	1.132 (3.616)
Development	0.627 (2.582)	0.947 (3.197)	0.370 (4.529)	0.607 (2.926)
N_household	-0.176 (-2.206)	-0.257 (-2.413)	-0.087 (-2.058)	-0.148 (-2.266)
N_income	0.242 (1.880)	0.369 (1.948)	0.140 (1.976)	0.253 (2.415)
δ		-0.277 (-0.904)		-1.034 (-6.340)
a_U			10.272 (21.831)	22.252 (12.788)
a_1			4.332 (30.476)	7.279 (15.323)
a_L			0.461 (4.410)	2.208 (4.311)
Log Likelihood	-432.641	-415.4862	-1143.2275	-1077.7249
N	431	431	614	614

In model 2, which drops NV samples, structural shift (δ) is negative but not significantly different from zero. This implies that there is no strategic downward bias when NV samples are dropped. In both models 3 and 4, all threshold parameters (a_U , a_1 , and a_l) are significant. In model 4, structural shift (δ) is negative and significant. There exists strategic downward bias when NV samples are included.

Table 4 shows the willingness to pay estimated by these models. Numbers in parentheses indicate 95% confidence levels, obtained using the method of Krinsky and Robb (1986) and based on 4,000 random draws. In model 4, the downward bias is 1,763 yen for the strong scenario and 1,112 yen for the weak scenario.

TABLE 4. Estimated Willingness to Pay

Strong		yen / household	
Model 1	WTP	1,307	[784 - 2,184]
Model 2	WTP	1,332	[710 - 2,443]
	DOWN	322	[-390 - 1,214]
Model 3	WTP	2,317	[1,754 - 3,040]
Model 4	WTP	2,735	[1,726 - 4,269]
	DOWN	1,763	[1,016 - 2,952]
Weak			
Model 1	WTP	587	[308 - 1,107]
Model 2	WTP	512	[265 - 993]
	DOWN	124	[-180 - 410]
Model 3	WTP	1,737	[1,377 - 2,180]
Model 4	WTP	1,725	[1,035 - 2,846]
	DOWN	1,112	[607 - 1,941]

NOTE: Numbers in parentheses indicate 95% confidence levels, obtained using the method of Krinsky and Robb (1986) and based on 4,000 random draws.

Table 5 shows the estimated results of first pilot survey that did not provide explicit NV options to respondents. The sample is 100; the NV sample is 5 (5%). This was a telephone survey that presented only the strong scenario. Structural shift (δ) is negative, but not significantly different from zero in both models 2 and 4. This implies there is no strategic downward bias when respondents were not provided an explicit NV option.

TABLE 5. Estimated WTP Function of Pilot Survey

	Model 1	Model 2	Model 3	Model 4
Constant	2.348 (8.764)	3.141 (1.739)	2.036 (4.916)	2.928 (4.978)
σ	2.348 (7.908)	13.485 (0.775)	2.914 (6.587)	2.952 (1.890)
ρ		0.281 (1.421)		0.891 (4.725)
δ		-8.632 (-0.744)		-0.315 (-1.047)
a_U			0.211 (0.996)	7.921 (1.534)
a_1			0.499 (2.030)	2.871 (1.781)
a_L			0.000 (0.000)	0.000 (0.000)
n	95	95	100	100
log likelihood	-138.2415	-119.6691	-167.589	-168.699

5. DISCUSSION

NV responses can be categorized into three basic groups: (1) scenario rejection, (2) strategic response, and (3) truth-telling, indifference between answering 'yes' or 'no'. Svento (1993), Svento and Mantymaa (1994), and Wu (1997) focused on the final category of NV responses using single-bounded CV. However, our double-bounded CV results show that NV responses are motivated not only by truth-telling, but also by strategic behavior.

The bivariate ordered probit model presented in this paper is able to analyze the incentive effects of NV options in double-bounded CV. The empirical results demonstrate that strategic downward bias is not significantly different from zero when dropping NV samples, yet it is significant when NV samples are included. This implies that NV respondents' preferences differ from others in the sample. Consequently, dropping NV respondents may cause sample selection bias. Furthermore, when the NV option was not explicitly offered, strategic downward bias was not significant with or without NV samples. Therefore, explicitly offering a NV option, as suggested by the NOAA panel, may strengthen strategic downward bias in double-bounded CV.

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