Je-Liang Liou (Taiwan)

Bias correcting model of starting point bias with censored data on contingent valuation method

Abstract

The purpose of this research is to construct a correcting model which can simultaneously consider the censored data characteristics and the starting point bias effect which usually occurs with the contingent valuation method. This is to solve the possible value miscalculation due to the contingent valuation method, especially when double-bounded dichotomous choice with open-ended method is selected. In order to understand the effectiveness of the correcting model constructed by this study, the author conducted an empirical estimation using survey data collected by the contingent valuation method. The differences between the conventional processing method and the correcting model constructed by the study were compared. According to the empirical results, the correcting model can capture the bias issue which is unavoidable when using the conventional evaluation method through the model's correcting mechanism. It is also able to calculate the true evaluation of the target goods in the participants' mind, and, thus, avoid overestimation or underestimation of the goods' value due to the bias effect.

Keywords: contingent valuation method, censored data, starting point bias, dichotomous choice elicitation method.
JEL Classification: C24, C51, Q51.

Introduction

In practice, it is hard to find an appropriate market to conduct direct or indirect evaluation for many ecological and species resources in environmental or natural conservation areas. This is especially so when we want to emphasize the value of ecological and species resources in environmental or natural conservation areas to human beings. Constructing virtual hypothetical scenarios for these resources allows human beings to reflect on the value when a scenario and changes is the only recognized method to know the monetary value of such resources (Cumming et al., 1986; Mitchell & Carson, 1989; Freeman, 2003). The contingent valuation method (CVM) is based on the aforementioned concept, and is an evaluation method applicable to nonmarket goods without a substantial market. When using CVM to conduct evaluation, the main task is to create a hypothetical market for the goods or resources through the design of questionnaires, and ask the participants what they are willing to pay for the nonmarket goods as customers. This is used to infer the resources' value.

The basic concept of CVM was proposed by Ciriacy-Wantrup in 1952. He believes that the most effective way to understand the value of specific resources to humans is to ask the potential customers. In order to understand the value of the goods in the participants' mind, we have to design a questionnaire encompassing what to ask and how to ask. What to ask involves describing the resources we are concerned about and their change. The method of asking involves using a kind of elicitation method and/or payment vehicle to make people reveal their willingness to pay (WTP) or willingness to accept (WTA) the goods and their change. In theory, it reflects the value or benefit people gain while consuming the nonmarket goods, or what they are willing to accept while reducing consumption.

In CVM methodology, it is necessary to design an elicitation method that can effectively capture the true WTP or WTA in the participants' mind. With the development of CVM, the existing literature has designed and used many different forms of elicitation methods. For example, in the early stage, the "bidding game method" applied by Randall et al. (1974), the "open question" used by Hammack and Brown (1974), the "single-bounded dichotomous choice" proposed by Bishop and Heberlein (1979), and the "double-bounded dichotomous choice" extended from "single-bounded dichotomous choice" by Carson et al. (1986) were methods used to induce the participants to show their WTP.

Among the elicitation methods, how to choose the most appropriate and efficient method is the key to the CVM questionnaire design. Amongst the various methods described above, the open question method allows participants to write down their WTP directly. However, without providing the amount, it is harder for the participants to imagine the value of the goods, which resulted in many of them leaving the question unanswered (Arrow et al., 1993). The advantage of double-bounded dichotomous choice is that participants only have to decide if they "agree" or "disagree" with the amount in the questionnaire. The amount provided serves as a reference to the participants. In addition to providing a relatively simple way for them to reply, it can also reduce the degree of strategic bias[1] (Hoehn and Randall, 1987). However, the disadvantage of double-bounded dichotomous choice lies in the limited scope of information gathered, which is narrower than the open

Je-Liang Liou, Assistant Research Fellow, The Center for Green Economy, Chung-Hua Institution for Economic Research (CIER), Taiwan.

[1] Strategic bias: due to safeguarding their own interests, the participants do not reveal the true values in their mind.

question format, thus making calculation of the average WTP more complicated (Wu et al., 2005).

More recently, some researchers have considered the complementarity of the double-bounded dichotomous choice and open question formats and designed the double-bounded dichotomous choice with open-ended elicitation method. Under this method, the participants have to answer the bid price in the double-bounded dichotomous choice phase before answering the open-ended WTP or WTA. This process helps the participants to clarify the true value of the goods in their mind before clearly answering a confirmed WTP or WTA. This method solves the difficulty of answering questions in the open question method, and also simplifies the method of estimation in the dichotomous choice method. In addition, past research shows that the average WTP calculated through this method is more effective than that via single-bounded or double-bounded dichotomous choice methods (Tisdell & Wilson, 2001; Wu & Su, 2002). As a result, the double-bounded dichotomous choice with an open-ended method has become the most common elicitation method of CVM (this elicitation method is shown in Figure 1).

However, the double-bounded dichotomous choice with open-ended elicitation method also has its drawback which can result in bias in the estimation of WTP and WTA. Firstly, this elicitation method includes two phases of dichotomous choices; and during each price enquiry, bid prices will be provided to the participants as a reference. The original purpose of provision of the bid price is to induce the participants to write down their true WTP or WTA. However, in reality, it is easy for the participants to view this price as the "pricing" of the resources, thus affecting the true WTP they perceive. If the participants think that the bid price in the questionnaire is the average market price of the goods, they might write down the weighted average of this bid price and their true WTP. As a result, the calculated average WTP might be overestimated or underestimated. This is the "starting point bias" defined in the literature (Boyle et al., 1985; Herriges & Shogren, 1996; Whitehead, 2002; Chien et al., 2005; Wu et al., 2005). If this bias exists, then the average WTP/WTA calculated from the prices acquired in the open question column will also be biased.

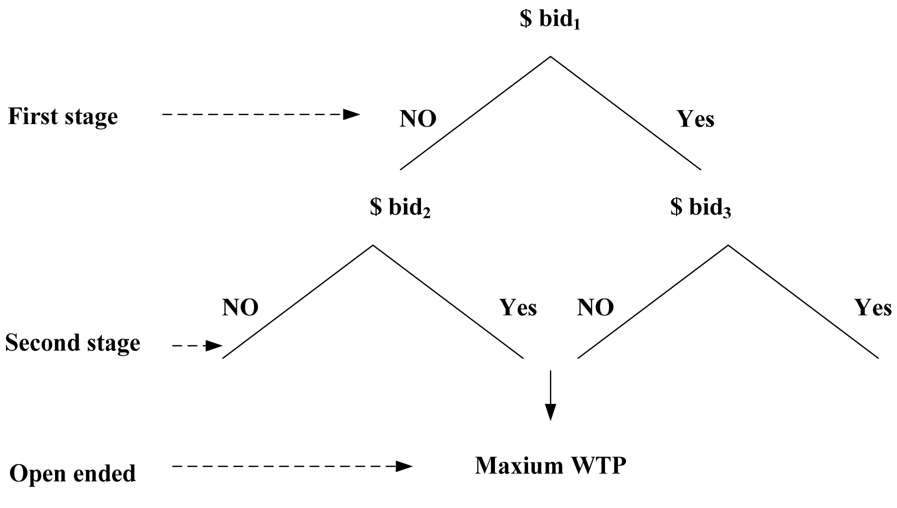

Fig. 1. Double-bounded dichotomous choice with open-ended elicitation method

Secondly, after the inquiry in the first and second phases, the participants will have a better idea about their true WTP. Therefore, if we ask the participants to fill in their highest WTP, it is the final result of a complete decision making process. This allows observation of the amount filled in by each participant. If the characteristics of the participant affects the final amount, this amount can be directly used for analysis. In general, if the target is of no value to the participant, then this participant's WTP/WTA will be at least zero, assuming that the participant does not show negative WTP/WTA. If the observed WTP/WTA is zero, it is likely to be true zero or a negative value. From the viewpoint of statistical distribution, the possibility of WTP/WTA being less than zero in the population distribution should be considered in order to obtain the correct estimation. However, when using a questionnaire as an interview tool, the collected data usually do not show negative WTP/WTA. This is the censored data characteristic as defined in the literature. In the CVM study using the double-bounded dichotomous choice with open-ended elicitation method, the aforementioned two characteristics that might cause estimation bias of WTP/WTA will exist simultaneously. However, in the existing literature, the researchers usually only consider one characteristic and ignore the other. As a result, bias is still unavoidable in the estimation of WTP/WTA. In view of the above research background, the purpose of this study is to construct a correcting model that can simultaneously consider the censored data attribute and starting point bias which will serve as a reference for the following research. In order to demonstrate the effect of the correcting model, the study also uses a set of CVM survey data to test it. This helps in understanding the similarities and differences between the conventional evaluation model and the correcting model constructed by this study.

The construction of a bias correcting model

The objective of this study is to construct a bias correcting model which can simultaneously consider starting point bias and censored data characteristics. We first explain how to deal with the two bias characteristics and then discuss the correcting model suggested by this study. In order to facilitate the description, the following paragraph uses the estimation of WTP as an example. The same method is adopted for WTA.

Regarding the estimation and correction of the starting point bias, according to the verification and correcting model proposed by Herriges and Shogren in 1996, they believe that when asked on the WTP (i.e., WTP_i^2) by the interviewer in the second stage of double-bounded dichotomous choice with open-ended elicitation method, participants view the WTP as a weighted average of true WTP (i.e., WTP_i) and the bid price (B_i^1) based on a certain ratio. The weight κ_1 is the "anchoring effect coefficient" defined in the literature as $0 \leq \kappa_1 \leq 1$. If the weight is closer to 1, it means the WTP_i^2 presented by the participant is closer to the bid price B_i^1 of the first phase, i.e., the anchoring effect of the starting point bias has greater impact on the result of estimation. In contrast, if κ_1 is closer to zero, the WTP_i^2 presented by the participant will be closer to the participant's true WTP_i. The impact of the starting bid price on the final average WTP is not obvious. Such a behavior is expressed in equation (1):

$$WTP_i^2 = (1-\kappa_1)WTP_i + \kappa_1 B_i^1 . \quad (1)$$

Equation (1) can estimate the value of the anchoring effect coefficient κ_1 of the starting point bias. Equation (2) can correct the WTP_i^2 in order to obtain the true WTP_i.

$$WTP_i = \frac{WTP_i^2 - \kappa_1 B_i^1}{(1-\kappa_1)} . \quad (2)$$

Secondly, we will consider the characteristics of censored data. Traditionally, the standard Tobit model is used to process the censored data. In the traditional standard Tobit model, if the WTP in participant *i*'s mind $WTP_i^T = \Delta e_i^T + \Delta\varepsilon_i^T$ is greater than zero, the participant *i*'s reply to the WTP_i^* is WTP_i^T; in contrast, if the participant's true WTP_i^T is less than or equal to zero, the participant *i*'s reply WTP_i^* is set to zero. Therefore, when the participant *i*'s reply to WTP_i^* is greater than zero, the corresponding probability is shown in equation (3):

$$Prob(WTP_i^* > 0) = \frac{1}{K^T} f_\varepsilon\left(\frac{WTP_i^* - \Delta e_i^T}{K^T}\right), \quad (3)$$

where $f_\varepsilon(\cdot)$ is the probability distribution function of standard distribution. K^T is the standard deviation of $\Delta\varepsilon_i^T$. If the participant *i*'s reply to WTP_i^* is zero, the probability is shown in equation (4):

$$\begin{aligned} Prob(WTP_i^* = 0) &= Prob(WTP_i^T \leq 0) \\ &= Prob(\varepsilon_i^T \leq \Delta e_i^T) \\ &= F_\varepsilon(-\frac{\Delta e_i^T}{K^T}) = 1 - F_\varepsilon(\frac{\Delta e_i^T}{K^T} . \end{aligned} \quad (4)$$

Combining equations (3) and (4), $\Delta\varepsilon_i^T$ the maximum likelihood function is shown in equation (5):

$$\ln L^T = \sum_{Y_i^*>0} \ln \frac{1}{K^T} f_\varepsilon\left(\frac{WTP_i^* - \Delta e_i^T}{K^T}\right) + \sum_{Y_i^*=0} \ln\left[1\text{-}F_\varepsilon\left(\frac{\Delta e_i^T}{K^T}\right)\right] . \quad (5)$$

As we can observe, the correction of the starting bias is to use equation (1) to characterize the correct WTP adjustment behavior. Upon completion of the coefficient estimation, behavior equation (2) will be used to estimate the true WTP. On the other hand, the processing of the censored data does not use the behavior equation as the basis for correction. Instead, it is corrected by the maximum likelihood function upon consideration of the probability distribution. Because they have different bases for correction, the behavior equation of the starting point bias does not interfere with the censored data characteristics, i.e., it will not affect the solving process of the likelihood function of the censored data. Therefore, when constructing a model simultaneously considering the censored data characteristics and starting point bias, the behavior equation of the starting point bias can substitute for the bid function in the traditional Tobit model. Technically, it is to substitute the WTP_i^* in equation (5) with equation (1), as shown in equation (6), and then estimate the coefficient according to the estimation process of the traditional Tobit model. At this moment, the estimated result still contains starting point bias; however, the problem of censored data has been solved. Finally, equation (2) is used to correct the starting point bias to obtain the unbiased estimation result.

$$\ln L^T = \sum_{Y_i^*>0} \ln \frac{1}{K^T} f_\varepsilon \left\{ \frac{\left[(1-\kappa_1) WTP_i + \kappa_1 B_i^1 \right] - \Delta e_i^T}{K^T} \right\} + \\ + \sum_{Y_i^*=0} \ln \left[1 - F_\varepsilon \left(\frac{\Delta e_i^T}{K^T} \right) \right] \quad (6)$$

Empirical data and model. This study uses CVM survey dataset of the conservation value of Chinese white dolphins (i.e., Sousa chinensis) conducted by the Environmental Protection Administration, Executive Yuan (2012) as the basis for simulation. The total sample size obtained from the survey is 409. Among them, 90 responses are protest responses, accounting for 22% of the total sample size. 82 responses are 'unknown' responses, as the participants could not determine the WTP in their minds. This accounts for 20.04% of the total sample size. Since these two types of responses will affect the evaluation result, they are excluded from this study. After deducting the "protest responses" and "unknown responses", the sample contains 235 remaining and effective responses left for the following WTP simulation, accounting for 57.5% of the total sample size. The variable definition of the empirical data and brief description of the statistical results are summarized in Table 1.

Table 1. Archive of the empirical variables (effective sample)

Variable symbol (unit)	Mean	Standard deviation	Definition of variable
Know	0.6085	0.4891	Dummy variable, 1 if the participant knows Chinese white dolphins; 0 for the rest.
See	0.0298	0.1704	Dummy variable, 1 if the participant has ever seen Chinese white dolphins, 0 for the rest.
Sex	0.4298	0.4961	Dummy variable for the participant's gender;1 for male, 0 for female.
Age	40.2809	46.2121	Age of the participants
Family (people)	4.3447	2.1073	Number of people cohabitating with the participant
Edu (Edu)	12.3532	3.6204	The participant's total years of education
Inc (10 thousand dollar)	41.8085	39.9603	The total income of the participant in 2011 (including salary, interest and bonus)
Mem	0.0851	0.2796	Dummy variable, 1 if the participant has ever been a member of environmental conservation organization; 0 if not.
Vol	0.1957	0.3976	Dummy variable, 1 if the participant has ever been an environmental volunteer; 0 if not.
Don	0.2085	0.4071	Dummy variable, 1 if the participant has ever donated to any environmental protection organization; 0 if not.
Job1	0.0681	0.2524	Dummy variable, 1 for military, public and teaching personnel; 0 for the rest.
Job2	0.1702	0.3766	Dummy variable, 1 for business personnel; 0 for the rest.
Job3	0.0255	0.1581	Dummy variable, 1 for agriculture and fishery personnel; 0 for the rest.
Job4	0.2638	0.4416	Dummy variable, 1 for finance and service personnel; 0 for the rest.
Job5	0.0936	0.2919	Dummy variable, 1 for freelancer; 0 for the rest.
Job6	0.1362	0.3437	Dummy variable, 1 for manufacturing and technology personnel; 0 for the rest.
Job7	0.2426	0.4295	Dummy variable, 1 for housekeeper, retiree and unemployed; 0 for the rest.
North	0.3660	0.4827	Dummy variable, 1 for those living in northern area; 0 for the rest.
Center	0.2298	0.4216	Dummy variable, 1 for those living in central area; 0 for the rest.
South	0.3319	0.4719	Dummy variable, 1 for those living in southern area; 0 for the rest.
East	0.0723	0.2596	Dummy variable, 1 for those living in western area; 0 for the rest.
Local	0.3149	0.4655	Dummy variable, 1 for those with geographical relation with Changhua; 0 for the rest.
W1	0.6894	0.4637	Dummy variable, 1 for answering "agree" in the first bid; 0 for the rest.
W2	0.5660	0.4967	Dummy variable, 1 for answering "agree" in the second bid; 0 for the rest.
Bid1 (dollar)	797.87	604.50	The bid amount in the first phase of the double-bounded dichotomous choice open-ended method
Bid2 (dollar)	1058.30	931.10	The bid amount in the second phase of the double-bounded dichotomous choice open-ended method
WTP (dollar)	946.04	1031.68	The average bid price in the open column

When using the double-bounded dichotomous choice open-ended elicitation method, it is possible to obtain a WTP/WTA value reply in the open column in the final stage of CVM questionnaire. Conventionally, the bidding function usually adopts the standard Tobit model and uses the

WTP/WTA data obtained from the open column for emipirical estimation. Technically, the likelihood function of standard Tobit model is shown as equation (5). In order to compare the difference between the correcting model constructed by this study and the traditional model, this study establishes two models for estimation (a) the standard Tobit model for processing censored data; (b) the correcting model constructed by this study. For the standard Tobit model, which only processes the censored data without considering starting point bias, the bid function is shown in equation (7). For the correcting model constructed by the study, the bid function is shown in equation (8).

$$\begin{aligned} WTP_i = {} & \beta_0 + \beta_1 Know + \beta_2 See + \beta_3 Sex + \beta_4 Age + \beta_5 Age^2 \\ & + \beta_6 Family + \beta_7 Edu + \beta_8 Edu^2 + \beta_9 Inc + \beta_{10} Inc^2 \\ & + \beta_{11} Mem + \beta_{12} Vol + \beta_{13} Don + \beta_{14} Job_1 + \beta_{15} Job_2 \\ & + \beta_{16} Job_3 + \beta_{17} Job_4 + \beta_{18} Job_5 + \beta_{19} Job_6 + \beta_{20} North \\ & + \beta_{21} Center + \beta_{22} South + \beta_{23} Local \end{aligned} , \quad (7)$$

$$\begin{aligned} WTP_i = {} & \left(1 - k_1\right) WTP_i + k_1 Bid_i^1 \\ & = (1 - K_1)(\beta_0 + \beta_1 Know + \beta_2 See + \beta_3 Sex + \beta_4 Age + \beta_5 Age^2 \\ & + \beta_6 Family + \beta_7 Edu + \beta_8 Edu^2 + \beta_9 Inc + \beta_{10} Inc^2 \\ & + \beta_{11} Mem + \beta_{12} Vol + \beta_{13} Don + \beta_{14} Job_1 + \beta_{15} Job_2 \\ & + \beta_{16} Job_3 + \beta_{17} Job_4 + \beta_{18} Job_5 + \beta_{19} Job_6 + \beta_{20} North \\ & + \beta_{21} Center + \beta_{22} South + \beta_{23} Local) + k_1 Bid_i^1 \end{aligned} . \quad (8)$$

In equations (7) and (8), β_0 is constant, and β_1 is the estimation coefficient of the corresponding variables.

Under the premise that a large sample approaches normal distribution, the average WTP in the confidence interval α of a particular significant level $CI_{1-\alpha}$ can be estimated by equation (9).

$$CI_{1-\alpha}\left[E\left(WTP\right)\right] = E\left(WTP\right) \pm t_{\frac{\alpha}{2}} \sqrt{\frac{\sigma^2}{N}} . \quad (9)$$

In the above equation, *E (WTP)* is the expected value of *WTP* perceived by participants. Under normal distribution, it is the average value of *WTP*; σ is the standard deviation of the expected value of *WTP* for all sample points; *N* is the number of respondents.

Comparison of the estimation result

The estimation results of the two different empirical models are summarized in Table 2. According to the results in Table 2 in model (a), in the standard Tobit model, which only considers the processing of censored data, the statistically significant non-zero coefficient estimations include: whether or not the participant knows what white dolphins are (Know), square of age (Age2), business personnel (Job2), and agriculture and fishery personnel (Job3). The average WTP is 31.9 dollars/person/year, calculated with the coefficient of the bid function estimated by this model and equation (9)[1]. In the 95% confidence interval (α = 5%), the interval of average WTP is 30.6~33.3 dollars/person/year. Secondly, in model (b): for the model that simultaneously considers the censored data and starting point bias, whether or not the participant knows what white dolphins are (Know), sex (Sex), age (age, age2), or whether the participant has ever been an environmental volunteer (Vol), as well as the bid in the first phase (bid), are all important factors affecting the bid for Chinese white dolphin resources. It's worth noting that the result of the bid coefficient estimation (the anchoring effect of starting point) is 0.5937, and it is statistically significantly different from zero. This indicates that the empirical data does have starting point bias. The participants are indeed misled by the bid price. Therefore, the WTP answered in the open column is not the true WTP. The average WTP is 36 dollars/person/year after the correction of starting point bias via equation (2) and calculated based on equation (9). In the 95% confidence interval, the average WTP is 35~37.1 dollars/person/year.

Table 2. The results of estimation of the empirical model

Name of variable	Model (a): Standard Tobit model		Model (b): The correcting model of this study	
	Estimated value of the coefficient	t-test value	Estimated value of the coefficient	t-test value
Know	237.94**	1.99	225.78**	2.04

[1] The average exchange rate of USD to TWD in 2012 was 1:29.08 (Central Bank of the Republic of China, 2015).

Table 2 (cont.). The results of estimation of the empirical model

Name of variable	Model (a): Standard Tobit model		Model (b): The correcting model of this study	
	Estimated value of the coefficient	t-test value	Estimated value of the coefficient	t-test value
See	-248.27	-1.36	-261.42	-1.45
Sex	-247.68	-1.62	-241.27*	-1.7
Family	6.24	0.25	7.50	0.29
Edu	-49.10	-0.74	-25.92	-0.41
Edu2	3.63	1.09	2.15	0.69
Age	-6.88	-1.46	-8.51*	-1.92
Age2	-0.015*	-1.92	-0.02**	-2.29
Inc	5.65	1.28	5.45	1.27
Inc2	-0.02	-1.22	-0.02	-0.99
Job1	222.52	0.76	275.43	1.03
Job2	376.24*	1.66	259.26	1.20
Job3	617.85**	2.39	336.93	1.19
Job4	86.99	0.54	47.88	0.33
Job5	94.26	0.40	133.17	0.69
Job6	7.54	0.04	-18.95	-0.10
Mem	-180.78	-0.59	-74.73	-0.26
Vol	392.44	1.51	419.37*	1.66
Don	134.11	0.70	159.62	0.91
Local	350.49	1.48	338.77	1.52
North	142.31	0.51	303.26	1.16
Center	-175.13	-0.67	94.58	0.40
South	116.01	0.45	247.58	1.05
Bid	-	-	0.5937***	5.82
Cons	657.58	1.00	68.11	0.11
F value	5.35***		6.29***	
Likelihood	-1899.4754		-1184.21	

Note: *represents significance at the 10% level. **represents significance at the 5% level. ***represents significance at the 1% level.

To estimate the impact on total value. The article assumes that the distribution of the sample is consistent with the population. Under this premise, the population of people aged over 20 in the Taiwan area is 17.946.858 in 2011. Assuming that the ratio of effective responses is the same as it would have been in the population (57.5%), then it is estimated that 10.319.443 (17.946.858*57.5%) people would bewilling to pay (including WTP = 0). When using the average WTP calculated using standard Tobit as the basis, the total value of Chinese white dolphins is 3.150 million ~ 3.440 million US dollars per year. On the other hand, by using the average WTP calculated from the correcting model constructed in this study as a basis, the total value of the Chinese white dolphin is 3.620 million ~ 3.830 million US dollars per year.

Comparing the estimated WTP/person/year and total value of the resources of the two models, the average WTP and total value of the resources estimated from the model constructed by the study are 12.9% higher than that of the standard Tobit model. The biggest difference between the standard Tobit model and the correcting model constructed by the study is that the former only considers the censored data characteristics the empirical data might have. The correcting model constructed by this study not only takes into account the censored data characteristics but also captures the effect of starting point bias. According to the estimation result of Table 2 under the premise that the variables are the same for both models, the censored data characteristics has been controlled for, and the starting point bias has significant impact on the data. The difference in average WTP might be due to the starting point bias. Overall, due to the impact of starting point bias, the WTP reported by the participant is lower than the original WTP in his/her mind, and thus the true value of the resource is underestimated.

Conclusion

This research investigated the WTP/WTA-censored data characteristics and starting point bias in the double-bounded dichotomous choice with open-ended elicitation method often used in CVM questionnaires. Traditionally, researchers have often used a standard Tobit model to conduct bid function analysis. However, this method only considers the censored characteristics of the survey data, but does not capture the impact of starting point bias. Therefore, this study constructs a correcting model that can simultaneously take these two characteristics into consideration in order to improve the possible estimation bias caused by the traditional standard Tobit model. This study also demonstrates the effect of the correcting model through a set of CVM empirical data. According to the empirical estimation result, in comparison with the correcting model constructed by this study, using the standard Tobit model for analysis will cause about 12.9% underestimation of the average WTP and total value of the resources. The reason for the underestimation is mainly due to the impact of starting point bias. In other words, the correcting model constructed by this study can indeed effectively capture the bias problem of the CVM empirical data, and correct it in order to avoid false evaluation of the value of the target goods. Regarding the research limitations and future research direction, first, the correcting model constructed by this study is focused upon the double-bounded dichotomous choice with open-ended elicitation method. In fact, the correcting model constructed by this study is also applicable to elicitation methods with more than double bounds. However, in order to take censored data into consideration, it is necessary to obtain WTP/WTA in the open column in order to use the correcting model constructed by this study. This is the limitation of the methodology. Regarding the future research direction, starting point bias is a common bias effect of the dichotomous choice method; however, aside from starting point bias, there are also other kinds of bias effect in the CVM bias research. Therefore, the future research can be based on the result of this study with correction of the behavior equation to extend the bias correcting ability of the correcting model.

References

1. Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Randner, R., and Schuman, H. (1993). Report of the NOAA Panel on Contingent Valuation, *Federal Register*, 58, pp. 4601-4614.
2. Bishop, R.C. and Heberlein, T.A. (1979). Measuring Values of Extra Market Goods: Are Indirect Measure Biased? *American Journal of Agricultural Economics*, 61 (5), pp. 926-930.
3. Boyle, K., Bishop, R., and Welsh, M. (1985). Starting Point Bias in Contingent Valuation Bidding Games, *Land Economics*, 61(2), pp. 188-194.
4. Carson, R.T., Hanemann, W.M., and Mitchell, R.C. (1986). Determining the Demand for Public Goods by Simulating Referendums at Different Tax Prices, Department of Economics, University of California, San Diego, mimeographed, cited by Cameron, T.A. and Quiggin, J. (1994). Estimation Using Contingent Valuation Data from a Dichotomous Choice with Follow-Up Questionnaire, *Journal of Environmental Economics and Management*, 27, pp. 218-234.
5. Central Bank of the Republic of China (2015). *Historical Foreign Exchange Database*. Available from: http://www.cbc.gov.tw/mp1.html.
6. Chien, Y.-L., Huang, C., and Shaw, D. (2005). A General Model of Starting Point Bias in Double-Bounded Dichotomous Contingent Valuation Surveys, *Journal of Environmental Economics and Management*, 50 (2), pp. 362-377.
7. Ciriacy-Wantrup, S.V. (1952). *Resource Conservation: Economics and Policies*, Berkeley: University of California Press.
8. Cummings, R.G., Brookshire, D.S., and Schulze, W.D. (1986). *Valuing Environmental Goods: An Assesssment of the Contingent Valuation Method*, Rowman & Allanheld publishers.
9. Environmental Protection Administration (2012). *An Examination and Application of the Social Cost-benefit Analysis in Environmental Impact Assessment for Development Projects*, Taipei: Environmental Protection Administration, Executive Yuan, Republic of China.
10. Freeman, A. Myrick (2003). *The Measurement of Environmental and Resource Values* (2nd ed.), Washington, D.C.: Resources for the Future.
11. Hammack, J. and Brown, G.M. Jr. (1974). *Waterfowl and Wetlands: toward Bioeconomic Analysis*, Baltimore: John Hopkins University Press for Resource for the Future.
12. Herriges, J. and Shogren, J. (1996). Starting Point Bias in Dichotomous Choice Valuation with Follow-Up Questioning, *Journal of Environmental Economics and Management*, 30, pp. 112-131.
13. Hoehn, J.P. and Randall, A. (1987). A Satisfactory Benefit Cost Indicator from Contingent Valuation, *Journal of Environmental Economics and Management*, 14, pp. 226-247.
14. Mitchell, R.B. and Carson, R.T. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, D.C.: Resources for the Future.
15. Randall, A., Ives, B., and Eastman, C. (1974). Bidding Game for Valuation of Aesthetic Environmental Improvements, *Journal of Environmental Economics and Management*, 1 (2), pp. 132-149.
16. Tisdell, C. and Wilson, C. (2001). Wildlife-based Tourism and Increased Support for Nature Conservation Financially and Otherwise: Evidence from Sea Turtle Ecotourism at Mon Repos, *Tourism Economics*, 84, pp. 233-249.
17. Whitehead, J.C. (2002). Incentive Incompatibility and Starting-Point Bias in Iterative Valuation Questions, *Land Economics*, 78 (2), pp. 285-297.
18. Wu, Pei-Ing, Liou, Je-Liang, and Su, Ming-Ta (2005). Effect of the Proffered-price in the Combination of Discrete-choice and Open-ended Type Contingent Valuation Experiment: Directing or Misleading? *Taiwan Journal of Applied Economics*, 77, pp. 1-43.
19. Wu, Pei-Ing and Su, Ming-Ta (2002). Design of an Efficient and Complete Elicitation Decision Process in Contingent Valuation Method: Benefit Evaluation of Kenting National Park in Taiwan, Paper Presented at the Second World Congress of Environmental and Resource Economists, Monterey, California, June 24-27.