TEMPORAL RELIABILITY OF ENVIRONMENTAL AMENITY VALUATION USING CVM

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1. Introduction

Contingent valuation method (CVM) is a willingess to pay (WTP) survey based approach in valuing non-marketed goods like natural preservation area. These areas of special natural features, in most cases, eventually become local ecotourism sites. In view of this, economic valuation of its amenity is important in policy involving demand management critical to its preservation. This study tests the temporal reliability of WTP estimates in support of benefit transfer application, i.e. using previously done value estimates or function as bases of new policy or decision making circumstances[1]. It mainly aims of to test the transferability of the WTP estimates and the stability of these economic values on the basis of two CV survey data taken five years apart.

2. Survey Data

An assessment of the temporal reliability of WTP estimates will be assessed on the basis of data on CV survey of the non-use value of the Aso Area, one of the biggest tourist attractions in Kyusyu. It was designated as National Park in December 4, 1934 and has an area of 727 sq. km. In 2001, about 16 million tourists visited the area.

Between 1998 and 2003, a few situational changes occurred. First, an access toll levied during the 1998 survey was already abolished during the 2003 survey. Second, a new tunnel providing better to the site was opened in the 2003 survey. In brief, the two surveys designed to value the area were conducted focusing on the same environmental good using the same valuation scenario, carried out in the same area, targeting same population but at different time periods. Table 1 describes the details of the two surveys.

Table 1. Characteristics of the 1998 and 2003 survey

	1998	2003
Date of survey	14-15 November 1998	03 November 2003
Samples	540	85
Target sample	visitors of the area	visitors of the area
Sampling method	choice-based sampling	choice-based sampling
Bid design	ten level bids DBDC (random 1st bid, next step 2nd bid)	ten level bids DBDC (random 1st bid, random 2nd bid)
Payment vehicle	environmental policy tax	environmental policy tax

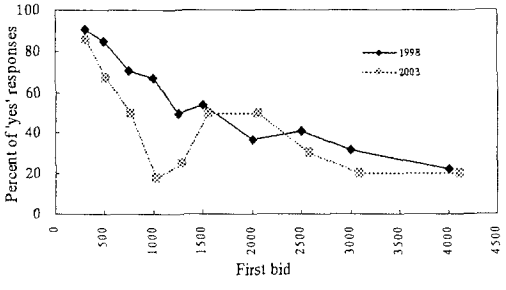

Figure 1. Distribution of 'Yes' vote in the first bid

[1]NOAA panel, which was co-chaired by Nobel laureates Arrow and Solow, formulated a set of guidelines for CV survey design, implementation, and data analysis. The panel recommends temporal averaging as a way of increasing reliability of estimates.

Though the same 1998 bid range was used in the 2003 survey, the pattern of bidding was altered to avoid bias related to anchoring. Existence of extreme values follow-up bids are however unavoidable in the revised bidding structure. Distribution of the percent of 'yes' votes in the first bid for the two surveys are shown in Figure 1. It can be seen from the figure that the distribution relatively follow the same configuration except for the bids in 1000.

3. Reliability Test of CV results

Reliability is the ability of a method or model to produce the same outcome across different place, different people and different time. One way of doing this is by checking equality of point estimates. The equality of mean and median value estimates and the function leading to its estimation is investigated in this study. This hypothesis is tested using two sample pooled t test (Walpole,1993 refers) with test statistic:

$$t = \frac{(\overline{C}_{T0} - \overline{C}_{T1}) - \delta_0}{\sqrt{(\sigma_{T0}^2 / n_{T0}) + (\sigma_{T1}^2 / n_{T1})}}$$

where $\overline{C}_{T0}$ and $\overline{C}_{T1}$ are the means, and σ_{T0}^2 and σ_{T1}^2 are the variances of period T0 and T1 respectively. Transfer errors of point estimates, are computed as:

$$\left(\frac{\overline{C}_{T0} - \overline{C}_{T1}}{\overline{C}_{T1}}\right)100\%$$

for T0 sample to T1 sample and vice versa. In doing these tests, the following more apparent causes of value difference are considered: (1) inflation/deflation of prices between time periods; (2) difference in questionnaire design; and, (3) unobserved explanatory variables.

Transfer errors are likewise computed to assess the transferability of values and value functions. Between 1998 and 2003, Japan experienced a deflation rate of about three percent. This will be use to adjust 2003 bids. The difference in the bidding design of the follow-up bid shall likewise be tested by including a parameter that will answer the anchoring effect of the second bid to the first bid. Unobserved new explanatory variables, dummy if the respondent knows the existence of the toll 5 years ago and the new tunnel that improves access to the Aso Area.

4. WTP Models and Estimates

Double bounded dichotomous choice (DBDC) was used to elicit WTP. This questioning format involves giving a follow-up bid after an initial bid C1, which takes on a higher value CU if the respondent answered 'yes' and a lower value CL, if the respondent answers 'no'. It follows that, for any underlying WTP distribution four interval probabilities can be derived from bounds CL, C1 and CU. The interval probabilities take the form $P^{YY} = 1 - \Phi(CU)$, $P^{YN} = \Phi(CU) - \Phi(C1)$, $P^{NY} = \Phi(C1) - \Phi(CL)$, and $P^{NN} = \Phi(CL)$. Using log-logistic distribution, the probability that a respondent reply 'yes' takes the form $\Phi(C) = 1/(1 - e^{-\alpha + \beta \ln C})$. This system of equations can be estimated using maximum likelihood procedure. Mean is computed as $e^{-\alpha/\beta}(\pi/\beta)/\sin(\pi/\beta)$ and median is equal to $e^{-\alpha/\beta}$. Variance is calculated using delta method and is denoted as follows:

$$\text{var}(e^{-\alpha/\beta}) = \left(\frac{e^{-2\alpha/\beta}}{\beta^4}\right)\left\{\beta^2 \text{var}(\alpha^2) + \alpha^2 \text{var}(\beta^2) - 2\alpha\beta\text{cov}(\alpha,\beta)\right\}$$

4.1 Univariate, anchoring and pooled model

Table 1 shows the univariate, with WTP as the only explanatory factor of the model, anchoring, and pooled model with time factor dummy. The 2003 models were corrected for depreciation using general consumer price indices. Median estimates decrease to about 31 percent from 1998 to 2003. Anchoring model include a parameter γ to check if the any significant effect was done by the difference in bidding design (Herriges and Shogren, 1996). This parameter measures the degree to which the respondent anchors his second answer to his answer, modifying the follow up WTP to $C_2 = (1-\gamma_{ANC})C_1 + \gamma_{ANC} C$. Results show no significant change in anchoring effect between the two surveys, meaning, bidding design did not significantly causes difference in estimates. Pooled model used combined data of the two surveys with additional dummy explanatory factor time. The time variable is significant which suggests that the models are not transferable.

Table 2. Parameter estimates of univariate, anchoring and pooled models

	1998		2003*		Pooled
N	540	540	85	85	625
α	11.691	11.399	10.807	10.753	11.623
	(15.3)	(15.6)	(7.9)	(8.1)	(17.2)
β	1.624	1.565	1.582	1.566	1.615
	(15.4)	(15.6)	(8.0)	(8.2)	(17.3)
γ anchoring bias		-0.025		-0.027	
		(6.9)		(2.6)	
τ time					0.588
(1998=0, 2003=1)					(2.5)
ρ^2	**0.32**	**0.32**	**0.34**	**0.34**	**0.35**
Median	**1336.8**	**1458.4**	**925.4**	**957.8**	**1336.8**
Mean	**2766.6**	**3231.6**	**2007.6**	**2118.1**	**2794.9**

**Corrected for price deflation*

4.2 Multivariate estimates

All multivariate models have high goodness of fit. 1998 data best fit model explanatory factors were used to model 2003 data.

Table 3. Parameter estimates of the multivariate model

	1998	2003*	
		Model 1	Model 2
α	12.584 (13.6)	10.900 (4.5)	13.321 (3.7)
β	1.632 (15.0)	1.732 (6.3)	1.749 (5.8)
Income Range 1 (2.5-5 M¥)	-0.496 (-1.8)	1.879 (2.1)	1.692 (1.9)
Income Range 2 (5 -7.5 M¥)	-0.543 (-1.7)	0.974 (1.0)	0.956 (0.9)
Aso terms	-0.061 (-1.3)	-0.112 (0.9)	-0.194 (1.1)
Environmental terms	0.034 (0.8)	0.213 (1.9)	0.228 (1.9)
Annual visit rate	-0.004 (-2.0)	-0.054 (0.4)	-0.023 (0.2)
Travel by car (Yes=1, No=0)	-0.281 (-1.1	-1.143 (1.0)	-1.326 (1.1)
Know new tunnel (Yes=1, No=0)			-0.760 (0.9)
Know toll (Yes=1, No=0)			-0.261 (0.4)
ρ^2	**0.75**	**0.77**	**0.77**
Median	**976.9**	**1492.2**	**2425.3**
Mean	**2005.2**	**2789.0**	**4468.6**

**Corrected for price deflation*

Significant changes in the behavior of the explanatory factor were observed due to the differences in the characteristics of the sample between periods. New explanatory factor in the 2003 model, i.e. new tunnel and abolition of toll, was introduced alongside 1998 explanatory factors. Result shows that both new variables are marginally significant.

5. Equality of CVM estimates

Using two sample t-test, equality of means of the CVM estimates was tested using null hypothesis $H_0 : \bar{C}_{T0}(1998) - \bar{C}_{T1}(2003) = 0$. Result of the estimates shows that the null hypothesis was rejected in the univariate but accepted in the multivariate model.

Table 4. Two sample T-test of equality of means

	Univariate	Multivariate
T statistic	10.19 (reject H_0)	-4.67(accept H_0)
V degree of freedom	101	193
P	1.000	0.000

Mean and median transfer error were consequently computed from the univariate and the multivariate models. Result shows transfer error of as high as 48.8 percent for median transfer error of 1998-2003 univariate model and as low as -28.1 percent for the mean of 1998-2003 multivariate model.

Table 5. Mean and median transfer error (%)

	1998-2003	2003-1998
Mean		
Univariate	41.9	-29.6
Multivariate	-28.1	39.1
Median		
Univariate	48.8	-32.8
Multivariate	-34.5	34.5

6. Conclusion

Point blank, comparing the mean and median WTP from the 1998 and 2003 survey appear to be significantly different. It is expected that, within the period, different sample characteristics has changed. However, various changes such as the removal of the area toll fee and the introduction of the new access tunnel seem not relevant to the transferability of the model. In terms of point estimates, the equality of mean hypothesis was accepted in the multivariate model but was rejected in the univariate model. This suggests that considering appropriate change in effect of the explanatory variables, point estimates of CV models may be transferable through time. It is deemed that factors leading to choices may tend to change through the years and if not considered may lead to a misleading result.

Using log-normal distribution the same model behavioral tendencies were observed. In terms of benefit transfer application, large sample CV survey result can be temporally transferred given proper consideration to changes in explanatory factors like demographic or socio-economic variables which can be derived trough secondary data or small sample CV survey.

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