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Testing for convergent validity between travel cost and contingent valuation estimates of recreation values in the Coorong, Australia*

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A number of studies valuing recreation have shown that the travel cost method (TCM) generates higher estimates of value than the contingent valuation method (CVM), even though the latter is commonly associated with potential problems of hypothetical and strategic bias. In this study, both methods have been used to estimate the recreational values associated with the Coorong on the Murray River in south-eastern Australia. Values per adult visitor per recreation day are estimated with the TCM at $149 and with the CVM at $116. A number of methodological and framing issues to explain these value differences are tested. In summary, while no single methodological or framing issue could be identified that would reconcile the difference between TCM and CVM values, it appears likely that there may be a combination of factors that drive the systematic variations in consumer surplus values. The evidence in this study suggests that the most important of these are likely to be the different decision points underpinning data collection and the consideration of substitute sites, strategic responses and the treatment of uncertain responses within the CVM.

Key words: contingent valuation, convergent validity, recreation, travel cost.

1. Introduction

The two most commonly applied methods to value outdoor recreation opportunities are the travel cost method (TCM) and the contingent valuation method (CVM) (Knetch and Davis 1966; Sellar *et al*. 1985; Carson *et al*. 1996; Shrestha and Loomis 2001; Loomis 2006). The TCM involves an analysis of revealed preference data, where the opportunity costs of travel and time to visit a recreation site are compared to information about the visit rate (Ward and Beal 2000, Haab and McConnell 2002). In comparison, the CVM involves an analysis of stated preference data, where the recreation users are asked in a survey format to state their preferences for visiting a recreation site under different opportunity costs (Mitchell and Carson 1989; Haab and

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McConnell 2002). Many applications of TCM surveys of recreation users are also suitable for an additional CVM question about whether the visit would have been made if there were additional costs involved (Haab and McConnell 2002).

Comparisons between TCM and CVM approaches to valuing outdoor recreation began soon after the inception of the two methods (Walsh *et al.* 1992). Earlier comparisons were focused on using the TCM values as an anchor for validating CVM predictions, but recognition in the late 1980s that both techniques involved different sets of assumptions led to a focus on convergent validity tests (Mitchell and Carson 1989; Cameron 1992; Loomis 2006). These were particularly powerful when the tests combined the results of a number of different studies into a meta-analysis to determine whether differences between value estimates could be explained by methodological and other factors. A notable outcome of the comparisons involving recreational values is that the CVM tended to generate lower value estimates than the TCM (Walsh *et al.* 1992; Carson *et al.* 1996; Shrestha and Loomis 2001, 2003).

Carson *et al.* (1996) reported a meta-analysis of 83 studies that allowed 616 comparisons between contingent valuation and revealed preference estimates, mostly involving recreation uses. They found a significant and high correlation between CVM and TCM values, with CVM estimates slightly (11 per cent) lower than the TCM estimates. Shrestha and Loomis (2001, 2003) performed a meta-analysis on 131 separate outdoor recreation studies in the United States involving 682 value estimates. Their results showed that CVM studies produced significantly lower estimates of consumer surplus (CS) than the TCM. Similar results have been found in other applications of meta-analysis. Woodward and Wui (2001) found that hedonic pricing and replacement cost methods generated higher values for wetland preservation than the CVM, while Brander *et al.* (2007) found that the TCM generated higher values than the CVM for recreation uses of coral reefs. In contrast, Brander *et al.* (2006) found that the CVM generated significantly higher values than other techniques for wetland preservation.

It is unclear why the CVM should generate lower values than a revealed preference method for the estimates of recreation values (Carson *et al.* 1996; Loomis 2006). While TCM uses data from actual choices and CVM uses stated preferences, the application of both techniques requires a number of modelling and statistical assumptions to be made (Cameron 1992). There are assumptions required in the TCM about the nature of the trips involved and the travel costs incurred, while application of the CVM requires assumptions about how respondents view contingent tradeoffs being offered. Both techniques require different functional forms and estimation procedures to be selected and involve slightly different measures of CS (Shrestha and Loomis 2003; Bergstrom and Taylor 2006). In applications of recreation studies, TCM studies are essentially an analysis of ex ante decisions where travel choices have been made prior to the event, whereas CVM experiments represent ex poste situations where respondents are asked about their tradeoffs after they have visited the site. Also, the hypothetical nature of the CVM means that there is some potential for different biases to affect results (Mitchell and Carson 1989).

There have been few studies focused on why the CVM tends to generate lower values for recreation benefits than the TCM (Loomis 2006). Carson *et al*. (1996) note that there are studies where the CVM estimates are much higher or much lower than the TCM estimates and that results are sensitive to the assumptions used by the analyst. Loomis (2006) reported a study where CVM values were approximately half of the TCM values but with overlapping confidence intervals. He showed that more systematic identification and partition of multiple destination trips in the TCM application helped to generate closer (but not identical) values from the two techniques. A range of other methodological issues that may potentially explain differences between value estimates are still to be explored.

The purpose of this paper is to explore some of the reasons why estimates of recreation values generated through the CVM tend to be lower than those generated through the TCM. The analysis is conducted through a case study approach of recreation values for the Coorong on the Murray River in the south-eastern part of Australia. The next two sections of the paper provide some background on the two assessment techniques and the case study of interest, followed in sections 4 and 5 by the results. An analysis of the differences in results and conclusions is provided in the final section. This overview of split-sample tests demonstrates that the differences between TCM and CVM estimates are limited, are not systematic and can be explained by a number of methodological and framing issues.

2. Theoretical frameworks for estimating recreation values

2.1 Travel Cost Method

The TCM has been widely employed over the past four decades to value outdoor recreational opportunities (Haab and McConnell 2002). Key advantages are that it is grounded in consumer theory, uses real data from market transactions and has the ability to represent consumer choices and preferences accurately (Haab and McConnell 2002).The technique has two basic variants depending on whether the visit rate as the dependent variable is defined in terms of a population group (the zonal model) or as an individual (the individual model) (Ward and Beal 2000). The zonal model is appropriate for sites that have very low individual visitation patterns, while the individual model is appropriate for sites that have high individual visitation rates (Ward and Beal 2000).

Earlier applications of the TCM employed standard regression techniques to identify the relationship between visit rates and independent variables such as travel costs and travel time (Feather and Shaw 1999). However, the non-negative integer and truncated nature of the dependent variable (visit rate) means that count data models such as Poisson or negative bionomial are more appropriate (Creel and Loomis 1990; Hellerstein and Mendelsohn 1993; Haab and McConnell 2002). In the Poisson model, the probability of an individual taking y trips can be modelled as (Haab and McConnell 2002):

$$\mathrm{Prob}(y = n) = \mathrm{Exp}(-\lambda) * \lambda^n / n! \tag{1}$$

where λ is specified as a function of travel, site and respondent characteristics, including travel cost (TC). The demand function for trips can be then expressed in the following variate:

$$\mathrm{Ln}\lambda = \beta_0 + \beta_{\mathrm{TC}} + \cdots \beta_n \mathrm{X}_n \tag{2}$$

An attractive feature of the model is that estimated CS per trip can be estimated as:

$$\mathrm{CS} = -1/\beta_{\mathrm{TC}} \tag{3}$$

Negative bionomial models are a more general form of a count data model than the Poisson model, where the assumption about the equality of the mean and variance is relaxed by incorporating an additional error term to account for systematic differences (Haab and McConnell 2002). This is important for data with overdispersion, where there may be a wide range of costs associated with a single trip frequency. Count data models may be further refined by correcting for endogenous stratification, where on-site sampling leads to over-representation of higher-frequency visitors (Englin and Shonkwiler 1995), and by bounding the potential visit rates with truncation (Englin and Shonkwiler 1995). Englin and Shonkwiler (1995) generated the appropriate correction factors for the negative bionomial model to account for overdispersion and truncation problem.

Loomis (2002) demonstrates that failing to correct for endogenous stratification leads to over-estimates of welfare benefits. However, the corrected model presented by Englin and Shonkwiler (1995) is rarely applied in case study analysis because most statistical programs do not include the routine. Analysts wishing to use the routine have to program their own maximum likelihood procedure for this purpose (e.g. McKean *et al.* 2003; Martinez-Espineira and Amoako-Tuffour 2008). However, the use of truncated negative bionomial models provides a convenient alternative as it generates very similar welfare estimates (Yen and Adamowicz 1993, Shrestha *et al.* 2002, Martinez-Espineira and Amoako-Tuffour 2008). The model is applied by truncating the visit rate at zero.

2.2 Contingent Valuation Method

The CVM can be used to value recreation by directly asking users about their expected CS they might enjoy (Bishop and Heberlein 1979; Haab and McConnell 2002). The technique involves the presentation of hypothetical scenarios to respondents in a survey format, where the scenario involves some tradeoff between the amount of a recreational amenity or environmental good and a monetary attribute (Mitchell and Carson 1989; Haab and McConnell 2002). By collecting a number of responses to these tradeoffs where there is some variation in the price and/or quantities of the good involved, a demand function can be estimated. There are a variety of formats in which the tradeoffs can be presented in CVM, as well as a number of approaches to performing the statistical analysis (Mitchell and Carson 1989; Haab and McConnell 2002). Here, the use of the basic random utility model for analysing dichotomous choice (referendum) CVM data is outlined.

In the referendum format, respondents are presented with a status quo option and a single improvement scenario involving a cost. In choosing whether to answer 'yes' or 'no' to the dichotomous choice, it is assumed, based on utility maximisation, that individuals choose options that are most likely to offer more utility (v). For a situation where a survey respondent is offered an increase in a recreational good (from q^0 to q^1) at an additional cost (\$$a$), the probability of a 'yes' response is given by the probability that the new situation has more utility for the individual than the old, as follows:

$$\Pr\text{ (response is yes)} = \Pr\{v(p, q^1, y - a, s) + \varepsilon \geq v(p, q^0, y, s) + \varepsilon\} \quad (4)$$

where v represents the indirect utility function for the individual, p represents the price of market goods, y represents income, s represents respondent characteristics, and ε represents the unexplained component of each choice.

This outcome can also be expressed in terms of the Hicksian measure of compensating surplus (c), which is the individual's WTP for a change from q^0 to q^1 that holds the initial level of utility constant. Under this formulation, compensating surplus is the amount that satisfies the relationship:

$$v(p, q^1, y - c, s) + \varepsilon = v(p, q^0, y, s) + \varepsilon \quad (5)$$

Compensating surplus represents the individual's maximum WTP for the change in the quantity of the recreational amenity. It follows that when the nominated bid a in a CVM survey is less than maximum WTP c, individuals will answer 'yes' and vice versa. Estimation of compensating surplus involves some allowance for random error components to allow for the stochastic nature of responses to the CVM tradeoffs (Haab and McConnell 2002).

Welfare measures are calculated from the resulting models by estimating either the mean or the median of the estimated WTP function. For example, the mean WTP that can be calculated from the logit model can be given as:

$$\text{Mean WTP} = (1/\beta_1)\ln(1 + e^{\beta_0}) \quad (6)$$

where β_1 is the slope of the function plotted against price and β_0 is the intercept value (Loomis and Ekstrand 1997, Carson and Hanemann 2006).

3. Case study and data collection

The Coorong is the estuarine region at the mouth of the Murray River and includes lakes at the river mouth and a series of lagoons stretching over 100 km southeast along the coast (Figure 1). The site is a designated Ramsar site of international significance for bird migration, feeding and breeding as well as being an important area for recreation and tourism use. In recent years, the combination of reduced rainfall and high levels of water extraction for agricultural and other purposes has reduced environmental flows down the Murray River and increased stress on resources, including those relating to recreational uses (Senate Standing Committee on Regional and Rural Affairs and Transport (SSCRRAT) 2008, Young and McColl 2009). While there have been a number of initiatives proposed by government to help protect the ecological assets of the Murray, most involving proposals to transfer water from consumptive uses to environmental flows (Young and McColl

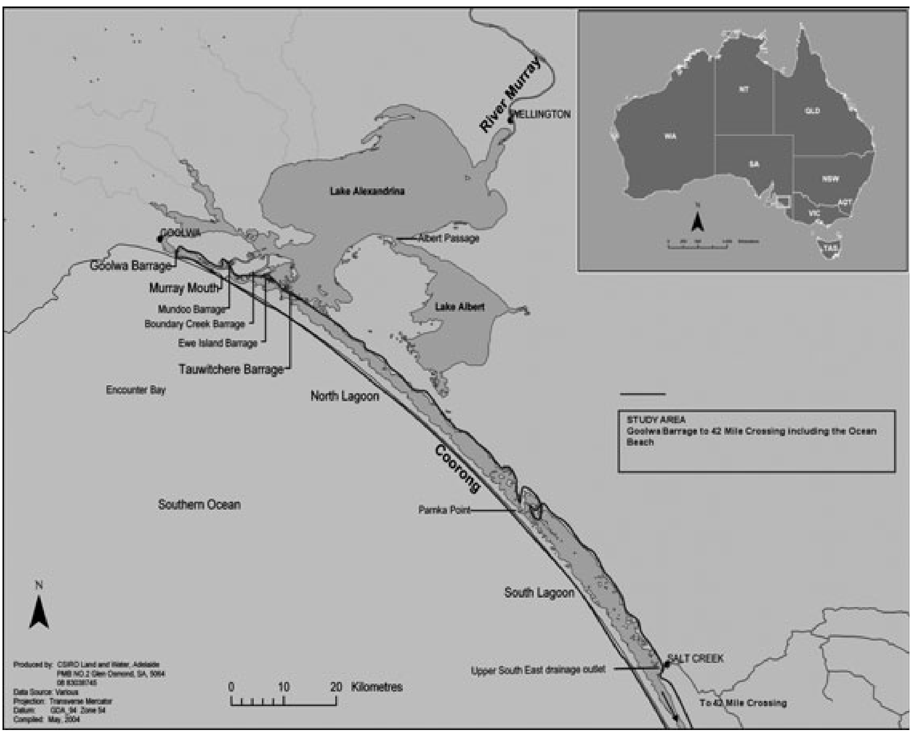

Figure 1 The location of the Coorong in Australia, as shown on survey cover. Source: CSIRO.

2009), there is very limited information available about the benefits that may be involved, including those associated with recreation.

Data about the value of recreational activities in the Coorong have been collected from a sample of recreational users at the site. The conduct of a primary valuation exercise was important to help identify if there were significant variations in recreation values across groups of users and to identify the key factors that influenced such values. The very limited pool of other recreation valuation studies in Australia (e.g. Knapman and Stanley 1991; Beal 1995; Bennett 1996; Whitten and Bennett 2002 and Griener and Rolfe 2004) ruled out the potential use of benefit transfer to estimate values.

In this study, information from recreational users was elicited with direct survey methods, using a paper-based visitor interception questionnaire administered in a drop-off/collect format at each site. Information from the questionnaire was designed to provide:

- feedback on current visitation rates and patterns;
- information about preferences and attitudes to recreation;
- background demographic characteristics of users; and
- values of current recreational activities (assessed with both travel cost and contingent valuation techniques).

Visitors to the sites were approached at random and asked to complete the questionnaire. The sampling occurred across a range of sites and time periods so that small ‘clusters’ of respondents were targeted to generate a representative sample of recreational users. The survey was conducted over a 4-month period from January to April 2006, with 790 successful completions. There were 100 nonresponses recorded for the Coorong, giving an overall response rate of 88.8 per cent. A summary of the characteristics of survey respondents is provided in Table 1, with further information provided in Dyack *et al.* (2007).

4. Estimating recreation values from the Travel Cost Models

The application of a travel cost model involves a number of assumptions about factors such as the specification of the dependent variable, the measurement of travel costs, the specification and measurement of other independent variables, the specification of the functional form and the appropriate integration procedure to calculate the estimates of CS (Ward and Beal 2000; Haab and McConnell 2002). Here, some of the assumptions underlying the analysis reported in the following sections are outlined in more detail.

The dependent variable in these individual travel cost models is the frequency of visits, with a 2-year time period chosen over a shorter time period (such as 1 year) to generate more variation in the visit rate.[1] Six observations

[1] Consumer surplus can be estimated per trip from count data models, which means that there is little difference in using 1- or 2-year trip rates as the dependent variable.

Table 1 Survey statistics for the Coorong

	Coorong	
	Mean	Std dev.
Respondents	790	
Average age (years)	47.1	13.0
Average income ($)	77 252	43 530
Households with income over $130 000 (%)	16	
Groups with young people (%)	37	
Retired respondents (%)	18	
Multidestination trips (number)	260	
Single destination trips (number)	529	
Day trip from home (number)	257	
Average distance from home	232	477
Distance from closest Capital City (Adelaide)	148*	
Average length of stay (days)	2.2	2.4
Average length of total holiday (days)	10.9	40.8
Average number of people in the group	3.3	1.6
Average number of adults in the group	2.7	2.4
Past visit rate – last 2 years	7.8	27.0
Expected visit rate – next 2 years	7.5	10.0

*Distance is average as the Coorong is over 100 km long.

with high trip rates that were identified as extreme values were omitted from the data sets. These were trip rates of 100 or more visits over a 2-year period.[2] An additional observation with missing data was also excluded, leaving a total of 783 valid observations.

There is little consensus in the literature about the correct method of estimating travel costs (Rolfe and Prayaga 2006). For this study, travel costs have been estimated as a function of distance travelled with variations for the car size,[3] together with additional costs such as accommodation (but excluding food) and an allowance for travel time at one-third of the average Australian wage rate.[4] The value of on-site time was not included in travel costs.[5] Travel costs for groups identified as being on a longer (multidestination) were assessed on the basis of a one-way trip, while groups making a dedicated trip to the Coorong had travel costs assessed for the return journey. The mean travel cost to the Coorong was estimated at $297.85 per group (standard deviation = 416.81).

[2] Trip rates in excess of 20 trips were extrapolated from respondent comments such as 'one trip per week' and may not have been very accurate.

[3] Cost rates from the Australian Taxation Office were used at $0.55 per km for small cars, $0.66 per km for large cars and $0.67 per km for four wheel drives.

[4] This was $22.68 per hour in 2006. No significant differences in trip values were generated by changing the proportion of the wage rate for estimating the cost of travel time or by excluding travel time from the estimation of travel costs.

[5] Testing showed no significant correlation between on-site time and travel costs and no significant difference in trip values when on-site time was included in travel costs.

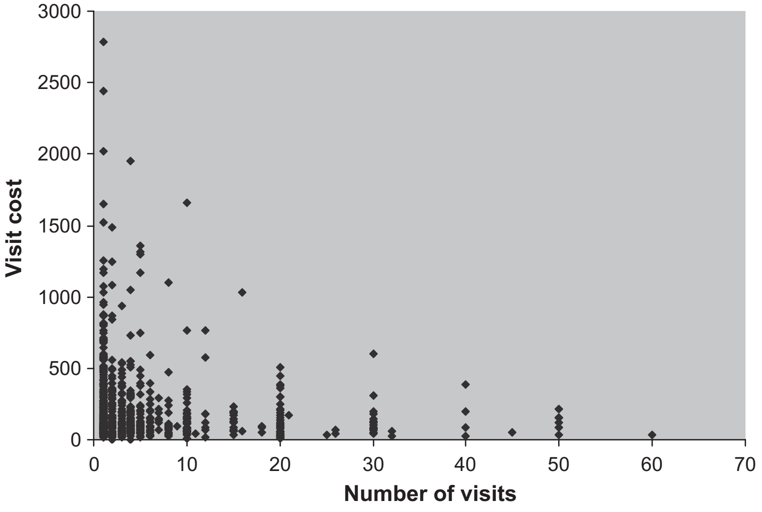

Figure 2 The relation of costs to the number of visits to the Coorong.

Other methodological issues can relate to incidents of multipurpose and multidestination trips (Mendelsohn *et al*. 1992; Parsons and Wilson 1997; Loomis 2006). Multipurpose issues were minimised by accepting all recreational activities at the site. Information was collected in the surveys about the different activities that people might have engaged in at the sites, as well as about some of the underlying reasons why they have made the trip. Problems of multidestination trips were minimised in this study by asking the survey participants to identify the number of days at the site and the total trip duration, allowing visitors on longer trips to be identified.

A graphical representation of the data relating the number of visits against the visit cost is shown in Figure 2. These data show the expected inverse relationship where the number of visits tends to diminish as travel costs rise. However, the data also demonstrate that the relationships are unlikely to be linear, and that the data are characterised by overdispersion (a wide range of costs associated with a single-trip frequency). Negative binomial models were used to address the issues of overdispersion, with the truncated form of the model used to correct for endogenous stratification (Table 2).[6]

Key model parameters are signed as expected, with expected number of trips declining as travel costs increase. Visit rates are likely to be higher if visitors were younger, have lower incomes and if there had been a history of visitation over the past 10 years. The parameter estimates for alpha confirm that overdispersion is present and that application of the negative binomial model

[6] Comparisons have been made between the truncated negative binomial model and Englin and Shonkwiler's corrected version of the model using the routine reported in McKean *et al.* (2003). There was no significant difference in model results, with the truncated negative binomial models generating slightly higher (1.5 per cent) estimates of CS.

Table 2 Negative bionomial travel cost model

	Coorong	
	Coefficient	Standard error
Constant	0.0308	0.1804
Travel cost	−0.0010***	0.0002
Travelled in 4WD (compared to small car)	−0.3900***	0.1546
Travelled in Large Car (compared to small car)	−0.2462**	0.1244
Brought tent	−0.2591*	0.1447
Repeat visitor over past 10 years	1.915***	0.1086
Activity – swimming	0.4954***	0.1797
Activity – canoeing/kayaking	0.2555*	0.1350
Activity – four wheel driving	0.6291***	0.1863
Activity – fishing from shore	0.5027***	0.1363
Activity – fishing from boat	0.4867***	0.1399
Believe environmental problems decreasing	0.7614***	0.1786
Age	0.1798**	0.1089
Income (per $1000)	−0.0020*	0.0011
Alpha (dispersion parameter)	1.5563***	0.2270
Number of respondents	783	
Log likelihood	−1690.2	
Restricted log likelihood	−2935.1	
Chi-square	2489.9	
Degrees of freedom	1	
McFadden's R^2	0.4241	
Consumer surplus/group ($)	$953.26	
CI (95%) for consumer surplus	$722.22–$1342.04	

***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

is appropriate. The CS per group visit is estimated with Equation (3) at $953. When this estimate is apportioned across visit length and adult group size (Table 1), the CS is estimated at $439 per group per day and $149 per adult person per visit day.

5. Estimating recreation values from the Contingent Valuation Models

The survey of recreation users also included a CVM question to ascertain values for the recreation experience. After respondents had completed the sections on travel costs, visit rates and other questions relating to their reasons and expectations for travel, they were asked whether they would have made the trip if it had cost a certain amount more. The location of the question meant that respondents were already aware of budget constraints and opportunity costs and were focused on the current trip. The CVM question was phrased as follows:

Q 12: *If the trip had cost $50 more for you for whatever reason, would you have still decided to come to the Coorong?*

No ☐
Yes ☐
Not sure ☐

Table 3 Summary of responses to contingent valuation method questions

WTP level	Number	% No	% Yes	% Not sure
\$10	125	3.2	85.6	10.4
\$20	129	5.4	74.4	17.1
\$50	132	12.1	70.5	16.7
\$100	138	29.7	50.0	18.8
\$200	129	36.4	40.3	17.1
\$400	132	42.4	26.5	23.5

The focus of the CVM experiment was on the individual response, so the term 'you' was highlighted in the question to emphasis this.[7] In the CVM dichotomous choice format, responses are ascertained when different prices are used. Six different levels were used for the payment bid in this experiment (\$10, \$20, \$50, \$100, \$200 and \$400). The wide range of bid levels was used to address uncertainty about the range of WTP for different respondents. Six different versions of the survey with the different CVM bid levels were offered at random to recreation users.

The survey included a 'Not sure' option to minimise the potential problems of yea-saying identified by Blamey *et al*. (1999), to avoid pressuring respondents into 'corner' responses and to allow some uncertainty in preferences formation (Ready *et al*. 1995). In line with common practice (Ready *et al*. 1995; Blamey *et al*. 1999), the 'Not sure' responses were coded as 'No' responses for the data analysis. A summary of the data received from the question is outlined in Table 3.

The pattern of responses shows diminishing levels of support as the cost tradeoff increases. To identify the relationship between response rates and the cost level, a standard logistic model was estimated using maximum likelihood methods (Table 4). The model fit is adequate (the rho-square value is above 0.1), and several variables apart from bid level are significant explanators of choice.

Estimates of CS have been generated using Equation 6, with confidence intervals calculated using the Krinsky and Robb (1986) procedure. As the CVM question was focused on individual responses, the CS estimates are values per person per trip (rather than per group). The most relevant comparisons are per individual per recreation day, as summarised in Table 5.

6. Discussion and conclusions

The results of this study confirm that the CVM technique tends to generate lower estimates of value than the TCM, with CVM estimates approximately 78 per cent of TCM estimates. The lower CVM values are consistent with the

[7] There is still a possibility that some respondents may have interpreted the task on behalf of their group, in which case the CVM values that are reported are over-estimates.

Table 4 Contingent valuation models

	Coefficient	Standard error	Mean of variable
Constant	−0.2742	0.1966	
CVM bid level	−0.0052***	0.0006	
Holiday staying at least one night	0.6917***	0.1741	0.359
Travelling in 4WD	0.5953***	0.1834	0.321
Travelling in boat	0.5015**	0.2236	0.183
Reason – quality time with family	0.3869**	0.1617	0.451
Reason – being close to water	0.2733*	0.1589	0.406
Reason – relaxing	0.4259**	0.1642	0.594
Reason – good for wellbeing	0.5206**	0.2435	0.138
Think recreation opportunities have been increasing	0.5297***	0.1931	0.238
Number of observations	783		
Log Likelihood	−458.8		
Restricted log likelihood	−534.8		
Chi-square statistic	152.1		
Degrees of freedom	9		
Psuedo R^2	0.142		

***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. CVM, contingent valuation method.

Table 5 Consumer surplus estimates for full-sample and split-sample models

	N	Coorong TCM	Coorong CVM	Poe *et al*. test
		CS/adult/day (95% CI)	CS/adult/day (95% CI)	Proportion of differences in $CS_{TCM} - CS_{CVM} > 0$
Full sample	783	\$149 (\$113–\$210)	\$116 (\$99–\$142)	0.069
No uncertain CVM responses			\$141 (\$121–\$169)	0.421
Single destination	528	\$135 (\$96–\$223)	\$137 (\$115–\$173)	0.192
Multiple destination	255	\$152 (\$91–\$491)	\$126 (\$96–\$211)	0.313
Substitute is home	208	\$115 (\$60–\$424)	\$104 (\$78–\$173)	0.419
Home decision	580	\$146 (\$65–\$117)	\$108 (\$92–\$133)	0.017
En route decision	203	\$127 (\$85–\$254)	\$164 (\$106–\$464)	0.760
Substitute is other murray	242	\$133 (\$87–\$246)	\$91 (\$74–\$120)	0.082
Substitute is other beach location	333	\$63 (\$46–\$106)	\$143 (\$108–\$219)	0.998
Repeat visitors	487	\$261 (\$149–\$853)	\$105 (\$90–\$130)	0.002
Once-off visitors	296	\$63 (\$38–\$184)	\$136 (\$99–\$226)	0.934

meta-analysis findings of Walsh *et al*. (1992), Carson *et al*. (1996) and Shrestha and Loomis (2001), while the actual scale of difference is higher than that reported by Loomis (2006). A Poe *et al*. (2005) test was conducted by comparing the CS estimates between the TCM and CVM models. Differences between the 1000-draw vectors of CS estimated with the Krinsky and Robb (1986) procedure were calculated over 1000 random draws and the proportion of differences from zero calculated. This simulation showed that the TCM estimates were higher than the CVM estimates at the 10 per cent level (93.1 per cent of simulations).

There are a number of potential reasons why the TCM appears to have provided higher values than the CVM, which can be summarised into framing and methodological issues associated with both techniques. Methodological issues that may have impacted on values estimated with the CVM include the elicitation format, payment vehicle and bid vector used, the treatment of 'unsure' responses and the type of functional form and statistical analysis employed. Not all of these issues can be tested in a single experiment.

It was possible to test for the treatment of the 'unsure' responses with split-sample models that excluded these responses from the analysis (Table 5). The removal of these responses increases CS values by 22 per cent with the Poe *et al.* (2005) test showing that significant differences in value estimates have been removed.

There are a range of methodological issues that can impact on value estimates for the TCM, including the estimation of travel costs, the treatment of multidestination and multipurpose trips, the treatment of travel time and on-site time and the type of function form and statistical analysis employed. Again, it was not practical to test for every potential issue affecting values in a single study. Tests revealed that inclusion or exclusion of travel time and on-site time in travel costs did not significantly influence value estimates. Other tests (not reported here for the sake of brevity) indicate little difference in trip values according to whether reported or estimated travel costs were used. Split-sample tests between the single destination and multiple destination visitors confirmed that values were not being artificially increased by the inclusion of the multidestination visitors (Table 5).

There are three key framing issues that may explain value differences: different decision points, substitute sites and strategic answers. The first framing issue is that there were different decision times for the TCM investment (prior to the trip commencing) and the CVM response (during the trip). It is possible that by the time that the CVM question was asked, better awareness of trip costs, the partial consumption of the recreation experience and additional budget constraints (following the trip expenditure) limited further willingness to pay.[8]

This hypothesis was tested by identifying whether estimates of WTP from split-sample TCM and CVM models differed between the group who made their travel decisions early (at home) and those who made them later (en route) (Table 5). The expectation was that differences between CVM and TCM values would be larger for those who made their decisions at home, in line with the difference in time between decision point and survey application. Results showed that while TCM estimates of value were higher for 'home

[8] One referee noted that better information could also diminish trip values if visitors were disappointed with site characteristics.

choice' visitors compared to 'en route choice' visitors, the opposite was true for values estimated with the CVM. The Poe *et al*. (2005) test showed that the difference between TCM and CVM values for the group making the decision at home was significant at the 5 per cent level, indicating that the hypothesis can be accepted.

The existence of substitute and alternative sites might explain higher values for TCM estimates, as people answering the CVM question may have considered other alternatives. The TCM estimates might have included both site values and more general values for activities across several possible sites, while the CVM values were focused on the specific site.[9] This was tested by asking respondents what their best trip alternative would have been and then comparing values to the CVM responses across different groups. There was some evidence from the Coroong sample that respondents would have travelled to substitute locations, with 28 per cent saying that they would have chosen another area on the Murray or Lower Lakes and 42 per cent saying that they would have chosen another location on the coast.

Recreation CVM values for those with a coastal substitute were higher than for other Murray or home alternatives (Table 5), suggesting that awareness of substitutes may be suppressing values for the Murray location. There were significant differences identified with the Poe *et al*. (2005) test between value estimates for other Murray substitutes (TCM values higher than CVM values) and for beach substitutes (CVM values higher than TCM values), confirming that substitute sites impact on value estimates.

It was also possible that the respondents were reluctant to express a high willingness to the pay to the CVM question if they were worried about future entry charges or other imposts. To test whether there was strategic bias in the results, tests were conducted to identify whether the CVM responses for the Coorong varied between the repeat visitors (who might have concerns about future entry charges) and once-only visitors (who would not be expected to have such concerns). The results do demonstrate some evidence of strategic bias, as comparison of the surplus values generated for the two groups (Table 5) shows that repeat visitors indicated significantly lower values with the CVM compared to the TCM.

This overview of split-sample tests demonstrates that the differences between TCM and CVM estimates are limited and not systematic. It is shown that within the one experiment values can be significantly higher from either technique for particular subgroups or that no significant differences in values exist. Results confirm that both TCM and CVM values are sensitive to framing and methodological issues, suggesting that it is unlikely that a single methodological variation can be used to minimise differences.

The results do indicate some key areas where differences between TCM and CVM values can emerge. The treatment of the 'unsure' responses in

[9] The extent to which respondents will consider substitute sites depends in part on whether they assume that increases in trip costs will apply to other sites as well.

CVM provides the most striking example, where exclusion of those responses from the analysis removed any significant difference between TCM and CVM values. It also appears likely that differences between TCM and CVM values in this study are driven by different decision points/information sets involved, the consideration of substitute sites and the opportunity for strategic responses. While other factors such as the treatment of multipurpose or multidestination sites also have the potential to create differences (Loomis 2006), the mechanisms used in this study to minimise differences have been successful. These results confirm the importance and potential for careful design to minimise differences between TCM and CVM values.

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