

# Testing the validity of responses to contingent valuation questioning<sup>†</sup>

Jeff Bennett, Mark Morrison and Russell Blamey\*

One way of assessing the validity of results generated through the application of the Contingent Valuation Method (CVM) is through the analysis of response sensitivity to factors expected to have an influence. Scope testing involves presenting at least two alternative impact scenarios to population sub-samples and testing for differences between the estimates generated. Most applications of the CVM in Australia have not involved scope testing and those that have yielded mixed results. These studies are reviewed. The results of scope sensitivity and other validity tests are presented for a study aimed at estimating the value of environmental damage caused by dryland salinity in the Upper South East of South Australia.

## 1. Background

Concerns regarding the validity of non-market benefits and costs estimated through the application of the Contingent Valuation Method (CVM) have limited the use of the technique in Australia and overseas. These concerns were most forcefully voiced in Australia following the release by the Resource Assessment Commission (RAC) of CVM-generated estimates of the environmental damage that would result from the establishment of a mine at Coronation Hill, adjacent to the Kakadu National Park. In the United States, controversy surrounding the technique reached a peak when the Federal Government and the State of Alaska filed suits against Exxon Corporation claiming damages following the grounding of the *Exxon Valdez*.

---

<sup>†</sup>A previous version of this article was presented as a contributed paper to the 41st Annual Conference of the Australian Agricultural and Resource Economics Society, Gold Coast, January 1997. Funding for the research reported was provided by the National Dryland Salinity Programme.

\*Jeff Bennett is Associate Professor, School of Economics and Management, the University of New South Wales (ADFA), Canberra, Mark Morrison is a PhD student in the same school and Russell Blamey is a Post-Doctoral Fellow, Urban Research Programme, Australian National University, Canberra. The comments of three anonymous referees are gratefully acknowledged but responsibility for any remaining errors or omissions is the authors.

The claims for damages were based on CVM-generated estimates of the costs incurred as a result of the oil spill.

The sources of potential bias in CVM estimates are numerous. For example, strategic bias is suggested to occur when respondents to a CVM question perceive some potential to influence the policy under consideration and do not respond with their true bid. Hypothetical bias is argued to occur when respondents do not believe that their answers will have any policy significance. Another form of bias that has been particularly prominent in the CVM literature has been the 'embedding effect'.

Originally brought to prominence by Kahneman and Knetch (1992a), the 'embedding effect' is said to occur when a CVM estimate of a non-market value is lower when it is valued as part of a more inclusive good than when it is valued alone. For example, an embedding effect would be said to occur if the value of a particular stand of remnant vegetation when estimated alone was \$100, while the value of the same stand was only \$15 if estimated as a part of, say, all remnant vegetation stands. The impact of the embedding effect, according to Kahneman and Knetch, is that CVM estimates of non-market values are unreliable. Specifically, they hypothesise that people respond to CVM questions in order to enjoy the 'warm glow' of giving. Hence, their responses relate not simply to the value they enjoy from a non-marketed good, but rather are confounded by the value they enjoy from the process of participating. Because of this confounding, values estimated through CVM applications are hypothesised to be largely invariant of factors that would *a priori* be expected to have an influence. Extreme variants of this hypothesis propose that all CVM-generated estimates are in the order of \$10 to \$60 (Cummings 1989) independent of what is being valued and by whom.

Smith (1992) and Carson (1995) helped to clarify the notion of embedding. They argued that the Kahneman and Knetsch view fails to specify correctly the nature of the issues involved. Carson (1995) recognised two separate 'components' of the embedding effect. First, there is what Kahneman and Knetch (1992b) in their reply to Smith (1992) termed the 'regular embedding effect'. This arises when the 'embedding' of substitute goods (say, alternative stands of remnant vegetation) under an umbrella good (all remnant vegetation) results in respondents lowering their marginal values for successive units of the substitutes. Comparing marginal value estimates from different sequences will therefore produce apparent inconsistencies which are simply reflections of the substitutability of the goods in question. This result was stressed by both Smith (1992) in a response to Kahneman and Knetsch and by Randall and Hoehn (1996) who demonstrated the existence of this type of 'embedding' in a market demand system. In other words, the 'regular embedding effect' is to be expected under the usual neo-classical

assumptions of economic behaviour. The critical question for CVM practitioners is: what array of substitutes should be used to embed the good of interest?

Carson's second component of the embedding effect is what Kahneman and Knetsch (1992b) called 'perfect embedding'. This is the situation referred to above where only the warm glow of giving is reflected in individual CVM responses. Hence, if 'perfect embedding' is present, respondents will be insensitive to the scope of the good they are asked to value. For example, the value estimated for a 100 hectare stand of remnant vegetation would be equal to the value estimated for that stand as well as a further 1000 hectare stand. 'Perfect embedding' is also referred to in the literature as 'part-whole bias' (Boyle, Desvousges, Johnson, Dunford and Hudson 1994). That is, the value estimates of the whole or composite good are found to be the same as the value estimates of parts of the good. In other words, the scope of the good has no impact on the value estimates generated.

The explanation of part-whole bias is extended beyond the 'warm glow' effect to include factors such as a lack of familiarity regarding the good on the part of respondents, changes in the likelihood of provision and an inability of respondents to distinguish between small changes in a good. Irrespective of the cause of the problem, the presence of these scope insensitivities presents an important test for CVM.

The importance of the scope sensitivity test was reinforced by a panel of experts set up by the US National Oceanic and Atmospheric Administration (NOAA) to report on the validity of the CVM. In their final report (Arrow, Solow, Portney, Leamer, Radner and Schuman 1993), the panel recommended a set of guidelines to be used as a means of assessing the validity of any CVM study. Specifically, and amongst other recommendations, they suggested that unreliable findings would be generated if inadequate responsiveness to the scope of environmental damage was found.

The fundamental test for 'perfect embedding' is straightforward. It requires the scope of the non-market good being valued to be varied across two sub-samples. Responses to an identical CVM question that is asked across both sub-samples are then compared to determine whether there are statistically significant differences. Carson (1995) suggested that further response validity testing can be achieved through the analysis of CVM response sensitivity to various respondent characteristics. He argued that, 'if one accepts the scope insensitivity hypothesis, then one would expect that willingness to pay *in general* would not vary with respondent characteristics' (p. 24). For instance, if the warm glow of giving was the principal driving force in CVM responses, there should be no relationship

between environmental value estimates and income, attitude toward environmental conservation or recreational experience.<sup>1</sup> The existence of a statistically significant (negative) relationship between value estimate and distance from the environmental good under consideration is a particularly useful indicator of scope sensitivity when the good generates tourist or recreation interest. Finally, sensitivity to price in a CVM based on dichotomous choice is another factor that reflects on the validity of responses.

Carson (1995) presented a review of 31 studies that have appeared since Kahneman's original 1984 presentation of the embedding effect. All but two of these studies reject the hypothesis that value estimates are insensitive to scope at the 5 per cent level of significance. The verdict is not, however, unanimous. As well as the two studies that directly showed insensitivity, others left some room for doubt. Carson put these apparent inconsistencies down to particular problems in individual applications of the technique. Further evidence of scope sensitivity came from Smith and Osborne's (1996) meta-analysis of 13 CVM studies of visibility at National Parks in the United States. Despite the strength of this evidence, the issue is still of sufficient importance for the NOAA panel to require specific testing of scope sensitivity in litigation-based CVM applications.

Carson's review of the evidence relating to scope insensitivity was international. Only two Australian studies were included. Applications of the CVM in Australia have been relatively rare and most have not undertaken scope sensitivity tests. Hence the evidence specific to the Australian context is limited. In the next section of this article, that evidence is reviewed. It is found that the picture is not as clear as the one Carson presents. The importance of scope testing — and potentially, exploring the nature of any insensitivity found — is therefore of critical importance to Australian applications of the CVM. In section 3 of the article, details of the scope testing, and other procedures designed to validate responses to CVM questions, carried out in an analysis of the value of environmental damage caused by dryland salinity in the Upper South East Region of South Australia are provided. Conclusions are drawn in the final section.

---

<sup>1</sup> Under this hypothesis, the potential for the warm glow of giving to vary across respondents is not recognised. It is conceivable that those with strong preferences toward environmental protection may experience different warm glow benefits from those with weak preferences for the environment.

## 2. The Australian evidence: Nadgee

Bennett (1981) presented an analysis of scope sensitivity in the context of a hypothetical proposal to protect an area of coastal ecosystem comprising Nadgee Nature Reserve on the NSW far south coast. Respondents to an open-ended CVM question were split into four sub-samples. Each sub-sample was presented with different information regarding the features of the area that would be lost if the protection proposal were not instituted. For the first group (224 respondents), a base level of features was described. For the second group (33 respondents), two birds were introduced as additional features. The third group (30 respondents) were given further information regarding the threatened status of the bird life while the fourth group (36 respondents) were told that the birds were in danger of extinction.

The scope tests presented by Bennett (1981) take the forms of analyses of variance and *t*-tests across the means of the distributions. No significant differences were found and the conclusion drawn was that 'changes in information do not have a significant effect on respondents' willingness to pay' (p. 274). This insensitivity to scope is interpreted by Bennett as possible evidence to support the hypothesis that hypothetical bias is present. That is, 'respondents have no incentive to consider their preferences carefully, and consequently, the bids of individuals are chosen more or less at random' (p. 275).

Because the Nadgee study was undertaken before Kahneman and Knetsch introduced the concept of embedding, there was no reference made to embedding *per se*. However, it is apparent that the hypothetical bias hypothesis put forward by Bennett closely parallels the 'perfect embedding' hypothesis of Kahneman and Knetsch (1992b).

It is doubtful that the scope insensitivity reported in Bennett (1981) presents a major challenge to the use of the CVM in Australia. The application used the open-ended questioning approach which is now regarded as inferior to the dichotomous choice approach. Other studies (e.g. Loomis, Lockwood and DeLacy 1993) detected scope insensitivity in open-ended format CVM results but not in dichotomous choice format results.<sup>2</sup> Carson's (1995) explanations of the presence of embedding in some studies may also apply. Respondents in the first group may have regarded the reserve they were considering as having the potential to harbour the birds detailed to other groups. In other words, the 'joint production' capacity of

---

<sup>2</sup> Open-ended format questioning may be more susceptible to scope insensitivity because of the comparative difficulty respondents face in specifying an exact willingness to pay amount.

the potential reserve was assumed by group one respondents. It is also possible, as Bennett (1981) noted, that the level of species rarity (threatened vs endangered) simply had no impact on willingness to pay. That is, the scope variation provided to the sub-samples was insufficient to trigger a change in marginal value. Furthermore, the size of the sub-sample may have been insufficient to detect statistically significant differences.

## 2.1 Coronation Hill

Perhaps the best known of the Australian CVM applications is the RAC estimation of the environmental costs likely to occur if mining were to be permitted at the Coronation Hill site, adjacent to Kakadu National Park. In that case, a specific scope test was incorporated into the survey design. Because of scientific uncertainty regarding the environmental consequences of the proposed mine, respondents were split into two sub-samples. One sub-sample was given a 'minor impact' scenario and the other, a 'major impact' scenario. The study was therefore designed to provide two points on a curve describing the relationship between damage and willingness to pay. Hence, the research design facilitated a scope sensitivity test. In addition, sampling was undertaken with a geographical variation. Two sub-samples were drawn: one Australia-wide (2034 respondents) and the other in the Northern Territory (502 respondents).

The results, reported in Imber, Stevenson and Wilks (1991) and Carson, Wilks and Imber (1994), indicate sensitivity of willingness to pay to the scope of environmental damage and distance at the 5 per cent level. Carson (1995) used the Coronation Hill study to exemplify the strength of rejection of the 'perfect embedding' hypothesis that is possible in 'in-person, contingent valuation studies . . . which use extensive visual aids and very clean research designs to value goods thought to have substantial passive use considerations' (p. 31).

It is ironic therefore that some of the most strident criticisms of the Coronation Hill results (for example, Brunton 1991) were targeted at the embedding effect. The critics of CVM were clearly unconvinced by the scope sensitivity tests presented. Perhaps this can partly be explained by some apparent contradictions presented by the results. For instance, the value estimates for the Northern Territory sub-sample were lower than the comparable estimates for the national sub-sample. This was used by Brunton to suggest that the 'moral free lunch' motivation (akin to the 'warm glow' motivation) was stronger in the areas of Australia far removed from the site, whereas the people whose livelihood was more likely to be directly affected by a ban on mining were far more pragmatic. This argument is somewhat

substantiated by the failure of the RAC study to yield a significant relationship between willingness to pay and income.

## 2.2 South East Forests (RAC)

The RAC's second major CVM application was centred on the estimation of the value of protecting old growth forests in the south east of Australia (RAC 1992). Variations in the scope of the good under consideration were provided by altering, across three sub-samples, the percentage of old growth forests currently outside of reserves that would be incorporated. The research design was thus formulated to estimate three points on the function relating area of protected forest to willingness to pay. Again, this facilitated a scope sensitivity test.

The evidence provided by the RAC study tended to oppose the scope sensitivity hypothesis. Increases in the area of forest to be protected were associated with reductions in estimated value. This conclusion is, however, relatively weak given that the probability of a 'yes' response to the dichotomous choice question was only affected slightly by the extent of the cost of protection specified. The median willingness to pay was therefore very sensitive to small changes in the slope of the logit function. It is also likely that the sub-samples presented with information relating to the scenarios of 100 per cent and 50 per cent of the old growth forests being protected may not have believed that such outcomes would be politically feasible. There is, however, the possibility that respondents had strongly held beliefs regarding the fate of the forests in question and 'voted' in their CVM responses either for or against protecting the forests, irrespective of the scope of the protection package on offer and ignoring the cost of that package.<sup>3</sup>

## 2.3 South East Forests (Loomis *et al.*)

The Loomis *et al.* (1993) study offered a more complete analysis of the embedding issue. The research design was formulated specifically to test for the presence of regular as well as 'perfect embedding'. Similar to the RAC's South East Forest study, the context of the analysis was the protection of unreserved National Estate forests through the conferring of National Park status. The steps in the commodity embedding were:

- South East Australia;
- East Gippsland (Victoria); and
- Errinundra Plateau (an area within East Gippsland).

---

<sup>3</sup> See Blamey, Common and Quiggin (1995) for an argument along these lines.

Results from the open-ended format CVM questioning yielded mixed results. Scope sensitivity was generated between Errinundra Plateau and East Gippsland but not between East Gippsland and South East Australia. For the dichotomous choice format, scope sensitivity was detected across all three sub-samples.

The presence of scope insensitivity between the South East Forests and East Gippsland in the open-ended version is explained by Fischhoff, Quadrel, Kamlet, Dawes, Fischbeck, Klepper, Leland and Loewenstein (1993) who argued that respondents assess the probability of larger programmes being implemented as being smaller than the more realistic smaller programmes. Hence, respondents downgraded their valuation of the South East Australia proposal because they saw it as unlikely to ever come to fruition. Loomis *et al.* argued that the use of a direct interview format, rather than a mail questionnaire, may assist in reducing the extent of scope insensitivity.

The conclusion Loomis *et al.* drew is that 'the occurrence of embedding effects is not always a pervasive feature of CVM studies if the regional context is clearly communicated to the respondent' (p. 54). It may equally have been stated that 'perfect embedding' (scale insensitivity) is a potential problem for CVM practitioners to avoid. Again, the evidence is mixed.

## 2.4 Jandakot wetlands

The context for Gerrans' (1994) analysis of embedding was the estimation of the value of the Jandakot wetlands in Perth. The scope variation was provided by the proposal to protect all wetlands in metropolitan Perth. In each of the two sub-samples, 140 respondents were surveyed. A dichotomous choice format of the CVM was used. The results indicated no significant difference between the willingness to pay for the Jandakot wetlands and for all metropolitan wetlands. In other words, scope insensitivity was detected.

Gerrans concludes that his tests are 'in no way definitive' and argues that the insensitivity may have come about simply because the marginal value of the protection of other Perth wetlands is inconsequential. However, he accepted that the evidence presented a weak case in support of the 'good cause dump' or 'warm glow' hypothesis of Kahneman and Knetsch (1992a).

## 2.5 An overview

Despite Carson's (1995) strident rejection of the 'perfect embedding' hypothesis, the Australian evidence is less conclusive. However, two things are immediately apparent from the studies reviewed above. First, it is critical



in any CVM application for the analyst to be aware of the possible occurrence of 'perfect embedding'. The context of the good under consideration must be carefully communicated to respondents. This will almost inevitably involve the use of preliminary surveys and focus groups to determine the degree of familiarity respondents have of the good as well as the array of substitute and complementary goods that are perceived as relevant by respondents. Pre-testing of questionnaires is also likely to be advantageous in checking for communication problems.<sup>4</sup>

Second, there remains a requirement for testing the validity of results against the perfect embedding hypothesis, specifically through the analysis of scope sensitivity. It cannot (as yet) be presumed that a CVM designed in line with the above recommendations (which are consistent with the NOAA panel recommendations), will not be subject to perfect embedding problems.

It was with these two points in mind that the issue of response validity was approached in a CVM application designed to estimate the value of environmental damage caused by dryland salinity in the Upper South East of South Australia.

### **3. The Upper South East case study: Background**

The aim of the CVM application reported in part here and in full in Bennett, Blamey and Morrison (1997) was the estimation of the value of damage to the environments of Tilley Swamp and the Coorong that would result from proposed drainage works in the Upper South East (USE) of South Australia. The drainage works are intended to reduce the impact of dryland salinity in the region. The construction of a pipeline to take the drained groundwater out to sea has been proposed to avoid changing the environments of the two wetlands.

The Coorong is part of a National Park and is listed as a wetland of international importance under the Ramsar Convention. The southern Coorong has an environment that is unique in Australia. It contains water that is hypersaline. In other words, the water in the Coorong is saltier than sea water. These conditions ensure the production of large amounts of aquatic plants and fauna. It is one of only a few major areas in southern Australia which is used by migratory and other water birds, particularly during drought times. Tilley Swamp is one of a series of shallow freshwater wetlands located inland from the Coorong. It contains an existing

---

<sup>4</sup> Much of the literature reviewed involves ex-post explanation of the presence of scope insensitivity. Focus groups and pre-testing can help reduce the prospect of such justifications of pre-determined positions.

conservation park and a further one is proposed. The primary vegetation in the wetland is tea tree. Tilley Swamp provides habitat and feeding areas for water birds and other fauna.

The questionnaire design phase of the study featured extensive qualitative background analysis of people's understanding of the issues involved, their ability to comprehend the concepts introduced and the framing of the environmental values under consideration. Specific attention was given to the selection of appropriate payment vehicles and elicitation formats. This research took the form of:

- an initial telephone survey of 134 randomly selected respondents in Sydney, Adelaide and Naracoorte (South Australia);
- a sequence of nine focus groups,<sup>5</sup> three in each of the above locations; and
- pilot testing of the questionnaire with 30 post-graduate management students<sup>6</sup> of The University of New South Wales.

The questionnaire and experimental structure were designed to enable a number of tests for response validity. Most significantly, to enable a scope test, two damage scenarios were portrayed to two splits of the sample. The first involved a description of damage done to Tilley Swamp only. The second involved the extension of this description to encompass damage done to the Coorong. The difference in the extent of damage between the two scenarios was deemed to be sufficiently great to avoid the prospect of scope insensitivity arising because of a low marginal value between the two scenarios. Tilley Swamp is both relatively small and unknown in comparison to the Coorong.

The second validity test embodied into the questionnaire and research design was a split in the sample across two geographic areas. Half the sample was drawn from South Australia with the other half coming from NSW. The hypothesis that this split enabled to be tested is that willingness to pay is sensitive to proximity to the damage site (and hence familiarity with the area and prospects for visitation<sup>7</sup>).

Other questions related to factors that would *a priori* be expected to have an impact on respondents' willingness to pay. These include environmental attitudes, behaviour relating to the environment and demographic characteristics.

---

<sup>5</sup> Each focus group involved eight respondents who had been selected at random by market research companies in Adelaide and Sydney.

<sup>6</sup> The students involved had no previous knowledge of the CVM.

<sup>7</sup> South Australian respondents were statistically more frequent visitors to the area.

### 3.1 The survey

A total of 1648 questionnaires<sup>8</sup> were mailed to individuals selected at random from the electoral rolls of NSW and SA. This sample was split into 16 different sub-samples, eight for each state. Four sub-samples were required to estimate the value of each damage scope for each state. This is because four different willingness to pay bid values were used to apply the dichotomous choice version of the CVM. Hence, for two damage scopes, eight sub-samples were required for each state. Each sub-sample consisted of 103 potential respondents.

The questionnaire was in the field from October to December 1996. One reminder card and a complete re-mail of the questionnaire were used to stimulate the response rate. An overall response rate of 47.3 per cent was achieved. For the SA sample, the response rate (54.4 per cent) was significantly higher than for NSW (40.2 per cent).

### 3.2 The sub-samples

All sub-samples used a standard dichotomous choice CVM question with an addition to income tax as the payment mode.<sup>9</sup> The dollar values for the sub-samples were varied across the amounts \$5, \$20, \$50 and \$100.

The sub-samples were split equally between two descriptions of the damage that would result from the drainage of saline water from the surrounding agricultural area into wetlands located along the USE coast. For the 'base-case' sub-samples, the damage was limited to Tilley Swamp. For the 'scoping' sub-samples, the Tilley Swamp damage was supplemented by a description of impacts to the Coorong. To ensure that respondents to the base case did not assume that damage would extend from Tilley Swamp to the nearby Coorong, the following statement was included:

*Other wetlands nearby, including the Coorong, will not be affected.*

Both versions of the questionnaire included maps drawn to the same scale. People were asked if they were willing to pay for a solution to the damage scenarios that was identical across the questionnaire versions. That solution involved the construction of a pipeline that would take the saline water (in an environmentally harmless fashion) to the ocean.

---

<sup>8</sup> The questionnaire is available upon request from the principal author.

<sup>9</sup> The income tax surcharge was used as the payment vehicle following the focus group research that preceded the questionnaire design phase of the study.

**Table 1** Response rates

Sub-sample		Total in sub-sample	Total returned (%)	Valid responses (%)
Base (Tilley Swamp)	\$5	206	50.5	40.8
	\$20	206	65.0	54.9
	\$50	206	58.3	47.1
	\$100	206	57.3	50.0
Scope (Tilley Swamp and the Coorong)	\$5	206	60.2	49.5
	\$20	206	55.8	42.2
	\$50	206	58.7	44.7
	\$100	206	63.1	50.5

The response rates (across both states) are presented in table 1. All sub-samples exceeded a 40 per cent response rate. Chi-squared tests were performed to ensure that the sub-samples were not statistically different from each other in terms of their respondent composition. These tests used the age, sex and income of respondents. No significant differences (at the 5 per cent level) between sub-samples were detected.<sup>10</sup>

### 3.3 Response validity tests

To test for sensitivity of responses to a range of factors that would be expected *a priori* to have an impact on willingness to pay, logit regression analysis was performed. Two types of models, each using different types of independent variables, were estimated: attitudinal/behavioural; and socio-economic. The distinction between the two model types was drawn because of the possibility of estimating spurious relationships. For instance, response to the specific issue at hand, the willingness to pay for the protection of the wetlands of the Upper South East Region, could be expected to be influenced by the same set of socio-economic variables as more generalised environmental attitudes and behaviours (see Blamey, Common and Quiggin 1995; Rolfe and Bennett 1996).

The dependent variable for both model types was generated from responses to the dichotomous choice CVM question. For each logit model, the dependent variable is the log of the odds of a respondent indicating that they would be willing to pay the assigned bid value. Respondents who

<sup>10</sup> Because a mail survey was used, no information regarding non-respondents — beyond their location — was collected. Hence, it is not possible to determine if respondents are statistically different from non-respondents.

protested against the income tax payment vehicle were excluded from the analysis.<sup>11</sup>

#### *Attitudinal/behavioural models*

A number of attitudinal/behavioural models were estimated. The following equation provided the best fit to the data (levels of significance are reported in brackets under each coefficient estimate):

$$\begin{aligned} \log\{pr(yes)/[1 - pr(yes)]\} = & 0.84 - 0.01 \text{ BID} + 0.65 \text{ SCOPE} \\ & (0.00) \quad (0.00) \quad (0.00) \\ & + 0.55 \text{ ATT} + 0.49 \text{ VIS} \\ & (0.01) \quad (0.01) \end{aligned}$$

(% correct prediction = 75.45;  $-2 \log \text{likelihood} = 683$  [*Chi-square*  $p = .0001$ ];  $N = 611$ )

where:

BID is the \$ amount of payment required in the dichotomous choice question;

SCOPE is the dummy for damage scenario, 1 = Tilley Swamp and the Coorong;

ATT is an environmental attitude dummy, 1 = environment is favoured more frequently than development when considering resource use projects; and,

VIS is a behavioural dummy, 1 = a visit to the area is planned in the future.

All the variables included in this equation have the expected sign and are significant at the 1 per cent level. As the bid amount was increased, fewer respondents agreed to pay the increased income tax to avoid the environmental damage described in the questionnaire. Respondents were more likely to support the proposal to avoid the specified environmental damage when it included the Coorong. Those respondents who in general favoured environmental options were more likely to favour the proposal to protect the wetlands. Those planning to visit the area were also more likely to favour the protection option. The strength of this estimation is supportive of the conclusion that the CVM responses recorded are valid.

<sup>11</sup> Deleting protest responses is standard practice in CVM studies. See, for example, Loomis, Lockwood and DeLacy (1993). Alternative treatments of protest responses are detailed in Bennett, Blamey and Morrison (1997).

However, some attitudinal/behavioural variables were omitted because of insignificance. These were dummies that indicated: state of residence; preference for buying environmentally friendly products; and past visitation to the site.

The insignificance of respondents' state of residence is difficult to interpret because, as was indicated above, the response rate in South Australia was substantially higher than in the NSW sub-samples. In part, the difference in response rates across the states can be regarded as indicative of a sensitivity of interest, and hence willingness to pay, to state of residence. A concern arising from the insignificance of the environmentally friendly products and past visitation variables is that they both relate to actual behaviour. This is in contrast with the significant ATT and VIS variables which relate to intentions. In other words, stated intentions of respondents to pay for wetland protection is better explained by environmentally related intentions than environmentally related behaviour.

#### *Socio-economic models*

The following equation provided the best fit to the data when socio-economic independent variables were considered:

$$\begin{aligned} \log\{pr(yes)/[1 - pr(yes)]\} = & 1.28 - 0.01 \text{ BID} + 0.61 \text{ SCOPE} \\ & (0.00) \quad (0.00) \quad (0.00) \\ & + 8.3E - 0.06 \text{ INCOME} - 0.44 \text{ CHILD} \\ & (0.04) \quad (0.07) \end{aligned}$$

(% correct prediction = 75.86;  $-2 \log \text{likelihood} = 599.9$  [*Chi-square*  $p = .0001$ ];  $N = 547$ )

where:

INCOME is household income in \$ per year; and,  
CHILD is a dummy set to 1 if respondent has dependent child(ren).

The strong significance and expected signs of the BID and SCOPE variables confirm the relationships established in the estimation of the attitudinal/behavioural model. The coefficient on the INCOME variable is positive (as would be expected) and significant at the 5 per cent level. The CHILD dummy is significant only at the 10 per cent level and has a negative sign. This indicates that respondents with children are less likely to support the proposal to protect the wetlands. It is difficult to establish any strong *a priori* expectation about the sign of the CHILD variable. While for some respondents having children would cause proposal support to increase through some form of bequest motive, for others, the increased household

**Table 2** Proportion of respondents agreeing to pay for each damage scenario by bid values

Bid value	Damage scenario	Proportion agreeing to pay (%)	Chi-square probability
\$5	Base	79	0.10
	Scope	88	
\$20	Base	75	0.32
	Scope	82	
\$50	Base	60	0.03
	Scope	77	
\$100	Base	59	0.01
	Scope	78	

expenditure associated with children would restrict the ability to afford an increase in their tax burden.

Similar difficulties are associated with determining expectations relating to other socio-economic independent variables such as age, sex and education. The insignificance of these variables when incorporated in the logit estimations is therefore perhaps not surprising. The STATE dummy variable was again insignificant.

Both types of logit models yield median bid value estimates for avoiding damage to Tilley Swamp and the Coorong of around A\$200 per responding household.<sup>12</sup> The estimates for avoiding damage to Tilley Swamp alone are in the order of A\$130. Even using conservative parameters for extrapolation to a wider population yields a total benefit for wetland protection that is clearly greater than the A\$4.4m cost of the pipeline proposed to avoid the environmental damage.

### *Proportion analysis*

To investigate further the nature of the sensitivity to variations in the scope of the environmental damage described to respondents, a three-way cross-tabulation of responses to the dichotomous choice question against the damage scenario for each bid value used was performed. This enables a breakdown of the relationship between proportion and scope and enables an analysis of the impact of differing bid values. The relevant data are reported in table 2.

<sup>12</sup> As a once-off increase in income tax.

The proportion data, when considered across the different bid levels, indicate a mixed picture. For the higher two bids, the Chi square statistics indicate that the proportions of respondents agreeing to pay under the two damage scenarios are significantly different. However, for the lower two bids, the proportions are not statistically different. Hence, scope insensitivity may be a problem for the \$5 and \$20 bid amounts even though the proportion agreeing to pay under the base damage scenario remains lower than the proportion agreeing to pay under the scope scenario for both bid values. One possible explanation of the apparent insensitivity is that respondents are equally willing to pay small amounts of money across different damage scenarios, but when larger amounts of money are involved, they become more selective about giving their support.

#### 4. Conclusions

The results of the Upper South East study are, in general, encouraging for the use of the CVM in Australia. The sensitivity to variations in the scope of the environmental damage reported to respondents suggests that 'perfect embedding' was not displayed by most respondents. This finding adds weight to the US evidence, as it is interpreted for the Australian context. Furthermore, the sensitivity of willingness to pay to both attitudinal/behavioural and socio-economic independent variables indicates that respondents were, by and large, reacting to the CVM questioning as would be expected, *a priori*.

The proportional analysis undertaken moderates this optimism. What the analysis shows is that scope sensitivity is a feature of CVM responses when bid values are at the high end of the range. When low bid values are presented to respondents, 'perfect embedding' may be a problem. Low bids may be regarded by respondents as trivial and the 'good cause dump' may become evident. The need for scope testing as a standard feature of CVM applications is therefore apparent.

In addition, the coefficient estimated for the BID independent variable is low across both logit models. This implies that the proportion of respondents agreeing to the proposal changes only very slightly over the range of bid values in the questionnaire. One consequence of this is that the median willingness to pay value is relatively high, a feature that is exacerbated by the now standard CVM practice of excluding payment vehicle protesters from the sample.<sup>13</sup> Hence, it is evident that continued development of the CVM will be required to increase the confidence with which the results of applications can be treated.

---

<sup>13</sup> When estimated using raw data, the median willingness to pay for the Tilley Swamp and the Coorong scenario falls to \$140. See Bennett, Blamey and Morrison (1997).



## References

- Arrow, K., Solow, R., Portney, P., Leamer, E., Radner, R. and Schuman, H. 1993, 'Contingent valuation methodology report, report of the NOAA panel on contingent valuation', *Federal Register*, vol. 58, no. 10, pp. 4602–14.
- Bennett, J. 1981, *Evaluation of the Benefits of Natural Ecosystem Preservation*, unpublished PhD, Australian National University, Canberra.
- Bennett, J., Blamey, R. and Morrison, M. 1997, *Valuing Damage to South Australian Wetlands Using the Contingent Valuation Method*, Land and Water Resources Research and Development Corporation, Occasional Paper No. 13/97, Canberra.
- Blamey, R., Common, M. and Quiggin, J. 1995, 'Respondents to contingent valuation surveys: consumers or citizens?', *Australian Journal of Agricultural Economics*, vol. 39, no. 3, pp. 263–88.
- Boyle, K., Desvousges, W., Johnson, F.R., Dunford, R. and Hudson, S. 1994, 'An investigation of part-whole biases in contingent valuation studies', *Journal of Environmental Economics and Management*, vol. 27, no. 1., pp. 64–83.
- Brunton, R. 1991, 'Will play money drive out the real money?', *Environmental Backgrounder*, no. 2, IPA, Canberra, pp. 1–9.
- Carson, R. 1995, *Contingent Valuation Surveys and Tests of Insensitivity to Scope*, mimeo, Department of Economics, University of California, San Diego, La Jolla.
- Carson, R., Wilks, L. and Imber, D. 1994, 'Valuing the preservation of Australia's Kakadu conservation zone', *Oxford Economic Papers*, vol. 46, Supplementary Issue, pp. 727–49.
- Cummings, R. 1989, *Comment Submitted to the Office of Environmental Project Review*, Department of the Interior, in response to ANPR Concerning Type B Natural Resource Damage Assessments, Washington, DC.
- Fischhoff, B., Quadrel, M., Kamlet, M., Dawes, R., Fischbeck, P., Klepper, S., Leland, J. and Loewenstein, G. 1993, 'Embedding effects: stimulus representation and response modes', *Journal of Risk and Uncertainty*, vol. 6, no. 3, pp. 211–34.
- Gerrans, P. 1994, *The Embedding Effect or Good Cause Dump Hypothesis in the Contingent Valuation Method — A Test*, paper presented to the 23rd Conference of Economists, Gold Coast, August 1994.
- Imber, D., Stevenson, G. and Wilks, L. 1991, 'A contingent valuation survey of the Kakadu conservation zone', *RAC Research Report*, no. 3, Commonwealth Government Printer, Canberra.
- Kahneman, D. and Knetsch, J. 1992a, 'Valuing public goods: the purchase of moral satisfaction', *Journal of Environmental Economics and Management*, vol. 22, no. 1, pp. 57–70.
- Kahneman, D. and Knetsch, J. 1992b, 'Contingent valuation and the value of public goods: reply', *Journal of Environmental Economics and Management*, vol. 22, no. 1, pp. 90–4.
- Loomis, J., Lockwood, M. and DeLacy, T. 1993, 'Some empirical evidence on embedding effects in contingent valuation of forest protection', *Journal of Environmental Economics and Management*, vol. 25, no. 11, pp. 45–55.
- Randall, A. and Hoehn, J. 1996, 'Embedding in market demand systems', *Journal of Environmental Economics and Management*, vol. 30, no. 3, pp. 369–80.
- Resource Assessment Commission 1992, *Forest and Timber Inquiry Final Report*, vol. 2B, AGPS, Canberra.
- Rolfe, J. and Bennett, J. 1996, 'Respondents to contingent valuation surveys: consumers or citizens? (Blamey, Common and Quiggin, AJAE 39:3) — a comment', *Australian Journal of Agricultural Economics*, vol. 40, no. 2, pp. 129–34.

- Smith, V. K. 1992, 'Comment: arbitrary values, good causes and premature verdicts', *Journal of Environmental Economics and Management*, vol. 22, no. 1, pp. 71–89.
- Smith, V.K. and Osborne, L. 1996, 'Do contingent valuation estimates pass a "scope" test? A meta-analysis', *Journal of Environmental Economics and Management*, vol. 31, no. 3, pp. 287–301.