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Scope Testing in Contingent Valuation

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Abstract

Following the Exxon Valdez oil spill, the US National Oceanic and Atmospheric Administration set up a panel to investigate the suitability of the Contingent Valuation Method (CVM) as a technique for the estimation of non-market values. One recommendation of that panel was for applications of the method to involve the testing of estimate sensitivity to the scope of the environmental impact under investigation. This involves at least two alternative impact scenarios being presented to population sub-samples and tests for differences between the estimates generated being undertaken. Significant differences across alternative scopes provides some confidence as to the reliability of the estimates. Most applications of the CVM in Australia to date have not involved scope testing. Those that included a scope test have yielded mixed results. A review of these studies is undertaken. The results of an intensive analysis of scope sensitivity in a study aimed at the estimating the environmental costs of dryland salinity in the Upper South East of South Australia are presented. In the study, the scope variation was provided by two scenarios of salinity damage to wetlands; one involving loss of environmental amenity in the little known Tilley Swamp, and the second expanding that loss to include the more environmentally significant Coorong. A further aspect of the study involves an investigation of differences in value estimates resulting from the geographic location of survey respondents. Sub samples answering the questionnaire were drawn from NSW and SA to enable this analysis.

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1. Background

Concerns regarding the validity of estimates of non-market benefits and costs estimated through the application of the Contingent Valuation Method (CVM) have limited the technique's use in Australia and overseas. These concerns were most forcefully voiced in Australia following the release by the Resource Assessment Commission 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, the 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. 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 willingness to pay question perceive some potential to influence the policy under consideration and do not respond with their true bid. Another form of bias, known as hypothetical bias, is hypothesised to occur when respondents do not believe that their answers will have any policy significance. However, one form of bias (if in fact it is a bias) that has been particularly prominent in the CVM literature has been the "embedding effect".

Originally brought to prominence by Kahneman and Knetsch (1992a), the "embedding effect" is said to occur when the CVM estimate of a non-market value is lower when it is part of a more inclusive good than when it is 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 Knetsch, is that CVM estimates of non-market values are unreliable because they are representative of other motives. 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 application are hypothesised to be largely invariant of the scope of the non-market good concerned. 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.

Smith (1992) and Carson (1995) have helped to clarify the notion of embedding. They argue that the Kahneman and Knetsch view fails to specify correctly the nature of the issues involved. Carson (1995) recognises two separate "components" of the Kahneman and Knetsch embedding effect. First, there is what Kahneman and Knetsch (1992b) in their reply to Smith (1992) term 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 were able to demonstrate 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 its presence begs of 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) call "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 are insensitive to the scope of the good they are asked to value: the value estimated for a 100 hectare stand of remnant vegetation is 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. 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 and an inability of respondents to distinguish between small changes in a good. Irrespective of the cause of the problem, the presence of scope insensitivities presents an important test for CVM.

The importance of the scope sensitivity test was reinforced by the panel of experts, co-chaired by Nobel laureates Kenneth Arrow and Robert Solow, 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 reliability of any CVM study. Specifically, and amongst other recommendations, they suggest that unreliable findings would be generated if inadequate responsiveness to the scope of the environmental damage was found.

The fundamental test for "perfect embedding" is straight forward. 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) suggests that further testing can be achieved through the testing of CVM response sensitivity to various respondent characteristics. He argues that "if one accepts the scope insensitivity hypothesis, then one would expect that willingness to pay *in general* would not vary with respondent characteristics" (p24). 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. 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 dichotomous choice format CVM is another factor that reflects on the validity of the "perfect embedding" hypothesis.

Carson (1995) presents 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% level of significance. The verdict is not, however, unanimous. As well as the two studies that directly show insensitivity, others leave some room for doubt. Carson puts these apparent inconsistencies down to particular problems for individual applications of the technique. Further evidence of scope sensitivity came from Smith and Osbourne's (1996) meta-analysis of thirteen CV studies of visibility at National Parks in the US. 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 generated CVM applications.

Carson's review of the evidence relating to scope insensitivity is international. Only two Australian studies are 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 paper, 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. Details of the scope testing carried out in a CVM analysis of the value of environmental damage caused by dryland salinity in the Upper South East Region of South Australia are provided in Section 3 of the paper. Conclusions are drawn in the final section.

2. The Australian evidence

2.1 Nadgee

Bennett (1981) presents 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 CV 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 was 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" (p274). 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" (p275).

Because the Nudge 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).

Does the scope insensitivity reported in Bennett (1981) present a major challenge to the use of the CVM in Australia? The answer is probably "no". The application used the open ended questioning approach which is now regarded as inferior to the dichotomous choice approach. Other studies (eg. Loomis, Lockwood and DeLacy, 1993) detected scope insensitivity in open ended format CVM results but not in parallel dichotomous choice format results. 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 the potential reserve was assumed by group one respondents. It is also possible, as Bennett (1981) notes, that the level of species rarity (threatened vs endangered) simply has no impact on willingness to pay. That is, the scope variation provided to the sub-samples is insufficient to trigger a change in marginal value.

2.2 Coronation Hill

Perhaps the best known of the Australian CVM applications is the Resource Assessment Commission's (RAC) estimation of the environmental costs likely to occur if mining was 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). Responsiveness of willingness to pay according to proximity to the mine site could therefore be assessed as a scope sensitivity test.

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 95% level. Carson (1995) uses 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" (p31).

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.

2.3 SE 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 tends to oppose the scope sensitivity hypothesis. Increases in the area of forest 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% and 50% 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 CV 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.

2.4 SE Forests (Loomis et al)

The Loomis et al (1993) study offers a more complete analysis of the embedding issue. The research design is formulated specifically to test for the presence of regular as well as for "perfect embedding". Similar to the RAC's SE 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:

- SE Australia
- East Gippsland (Victoria)
- Errinundra Plateau.

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 SE Australia. Regular embedding was detected between the questioning involving all three levels and that involving two. However, it was absent in comparisons between the two level results and the sample involving only the Errinundra Plateau. For the dichotomous choice format, scope sensitivity was detected across all three sub-samples.

The presence of scale insensitivity between the SE Forests and East Gippsland in the open ended version is explained by Fischhoff et al (1993) who argue that respondents assess the probability of larger programmes being implemented as being smaller than the more realistic smaller programmes. Hence, respondents would down grade their valuation of the SE Australia proposal because they see it as unlikely to ever come to fruition. Loomis et al argue 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 draw 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" (p54). 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.

2.5 Jandakot wetlands

The context for the 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. 140 respondents were surveyed in each of the two sub-samples. 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 the willingness to pay 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 does accept that the evidence presents a weak case in support of the "good cause dump" or "warm glow" hypothesis of Kalneman and Knetch (1992a)

2.6 An overview

Despite Carson's (1995) strident rejection of the "perfect embedding" hypothesis, the Australian evidence suggests that the jury is still "out" in this country.

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 are likely to 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.

Second, there remains a requirement for scope sensitivity testing. It cannot (as yet) be presumed that a CVM designed in line with the above recommendations, that a.e., incidentally, in line with the NOAA panel recommendations, will not be subject to "perfect embedding" problems.

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

3. The Upper South East Case Study

3.1 Background

In January 1996, Environmental and Resource Economics (ERE) was contracted by the Australian Bureau of Agricultural and Resource Economics (ABARE)¹ to undertake a non-market valuation case study. The ERE team assembled to perform the work comprised the authors of this paper. The aims of the study were to test the CVM and to help in its development in the Australian context. The specific case to be addressed was the estimation of the value of changes to the environments of Tilley Swamp and The Coorong that would result from proposed drainage works in the Upper South East of South Australia. The drainage works are intended to reduce the impact of dryland salinity in the region².

The questionnaire design phase of the study featured extensive qualitative background analysis of peoples' 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 respondents in Sydney, Adelaide and Naracoorte (in the Upper SE);
- a sequence of nine focus groups, three in each of the above locations; and,

¹ The views and opinions expressed in this paper are those of the authors and not ABARE.

² For a complete report of the case study, see Bennett, Blamey and Morrison (1997).

- pilot testing of the questionnaire with 30 post-graduate management students of UNSW.

The questionnaire and experimental structure were designed to enable a number of tests for scope sensitivity. Most significantly, 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, weaker, specific scope sensitivity 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 proximity to the damage site (and hence familiarity with the area and prospects for visitation) is negatively related to willingness to pay.

3.2 The survey

Datacol Pty Ltd was contracted to manage the logistics of the survey. A total of 4120 questionnaires³ were mailed to individuals selected at random from the electoral rolls of NSW and SA. This sample was split into 40 different sub-samples, 20 for each state. Given the need for four bid values to be included for each dichotomous choice CVM estimation, this leaves the following splits for hypothesis testing:

- scope sensitivity (two alternative damage scenarios);
- payment vehicle sensitivity (water rates and income tax); and,
- Elicitation format (dichotomous choice, "polychotomous" choice and a dissonance minimising format)⁴

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% was achieved. For the SA sample, the response rate (54.4%) was significantly higher than for NSW (40.2%).

3.3 The sub-samples

The sub-samples of relevance to the analysis of scope sensitivity all used a standard dichotomous choice CV question with an addition to income tax as the payment mode. The dollar values for the sub-samples were varied across the amounts \$5, \$20, \$50 and \$100. Sub-samples were taken in both NSW and SA.

³ The questionnaire is available upon request from the principal author.

⁴ For details of the elicitation format results, see Blamey, Bennett and Morrison (1997)

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.

Same scale maps were included in both versions of the questionnaire. The solution to both damage scenarios which people were asked to pay for, was identical. It involved the construction of a pipeline that would take the saline water (in an environmentally harmlessly fashion) to the ocean.

The response rates (across both states) for the two sets of sub-samples relevant to the scope testing are presented in Table 1. All sub-samples exceeded a 40% 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 95% level) between sub-samples were detected.

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

3.4 Scope sensitivity tests

Two types of scope sensitivity tests were undertaken. The first involved the analysis of the proportion of respondents agreeing to pay the bid value in the dichotomous choice CV question across the sub-samples. The second used logit estimation techniques to determine

the impact of the scope variations between sub-samples on the respondents' dichotomous choice responses.

3.4.1 Proportion analysis

Under the hypothesis that there is sensitivity to the scope of environmental damage described to respondents, the proportion of respondents agreeing to pay the dichotomous choice bid amounts should be statistically significantly higher in the scope (Tilley Swamp and the Coorong) sub-samples than the base (Tilley Swamp only) sub-samples. This can be tested by cross-tabulating responses to the dichotomous choice question against the degree of damage described and considering the chi-squared and Fisher's Exact statistics. Table 2 presents this analysis.

Table 2: Dichotomous choice response for each damage scenario.

Damage scenario	Dichotomous choice response (N = 764)		Chi-square probability	Fisher's (1 tail) Exact probability
	Yes (%)	No (%)		
Base	56	44	0.001	5.8E-04
Scope	68	32		

The clear significance of the difference between the base and scope scenarios is apparent from these data. The Fisher's Exact test is one tailed so it is possible to give direction to the difference - the scope "yes" response is significantly higher than the base "yes" response. Support is therefore provided for the scope sensitivity hypothesis.

However, the data presented in Table 2 are aggregated across the range of bid values presented to sub-samples for the dichotomous choice question. A more refined analysis of scope sensitivity involves the consideration of the proportion of "yes" responses according to damage scenario for each of the four bid values. This breakdown of the relationship between proportion and scope enables an analysis of the impact of differing bid values. Table 3 contains the relevant data and Figure 1 provides a graphical illustration of these data.

Table 3: Proportion of respondents agreeing to pay for each damage scenario by bid values.

Bid value	Damage scenario	Proportion agreeing to pay (%)	Chi-square probability	Fisher's Exact (1 tail) probability
\$5	Base	72	0.19	0.13
	Scope	80		
\$20	Base	62	0.50	0.3
	Scope	67		
\$50	Base	48	0.01	0.01
	Scope	66		
\$100	Base	45	0.06	0.04
	Scope	58		

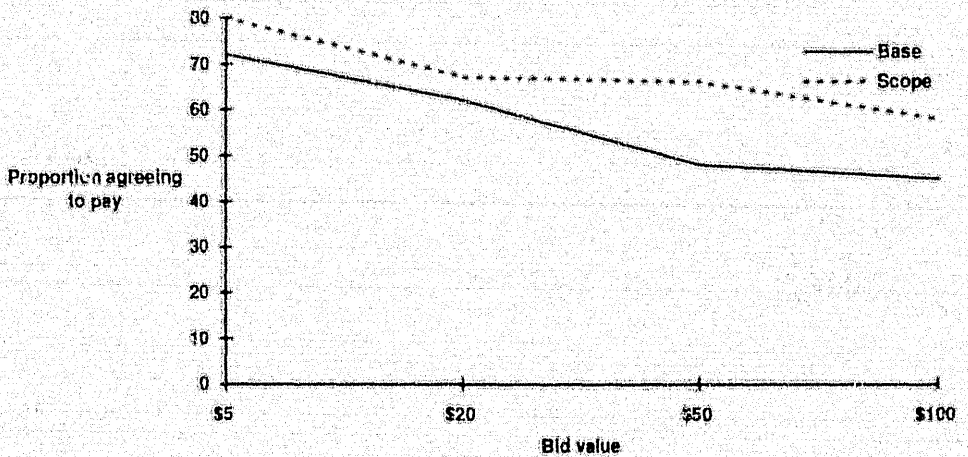


Figure 1: Scope differences in proportion agreeing to pay

The proportion data, when considered across the different bid levels, indicate a mixed picture. For the higher two bids, there are strongly significant differences between the two damage scenarios. For the lower two bids, the proportions are not statistically different. Hence, scope insensitivity appears to be a problem for the \$5 and \$20 bid amounts. One possible explanation of this feature 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.

3.4.2 Logit analysis

The proportional analysis presented above is limited because it does not incorporate all the factors that may cause respondents to agree to pay the specified bid amount. A more complete specification of that causal relationship which incorporates the variation in scope as one of the factors of influence is of greater use in determining scope sensitivity. This can be achieved through the estimation of a logit regression expression to explain the dichotomous choice responses across the two sub-samples relevant to the scope testing.

To facilitate this test, two dummy variables were created. The first dummy, SCOPE, is set equal to 1 for the scope sub-samples and 0 for the base sub-samples. The second dummy, STATE, is set equal to 1 for SA sub-samples and 0 for NSW respondents. A significant (and positive) co-efficient on the SCOPE dummy would indicate scope sensitivity for the damage description. A significant (and positive) co-efficient on the STATE dummy would indicate sensitivity to the location of residence of the respondent.

A number of alternative logit models were run and from these, the following equation was selected as providing the best fit to the data⁵. Standard error statistics are presented under the estimated co-efficients.

$$\log \{pr(yes)/[1-pr(yes)]\} = 0.29 - 0.01 BID + 0.43 SCOPE + 0.69 ATT + 0.65 VIS$$

$$(0.16) \quad (0.002) \quad (0.16) \quad (0.18) \quad (0.16)$$

(% correct prediction = 66.8%; -2 log likelihood = 909; N=741)

All the co-efficient estimates except the constant are significant at the 99% level.

(where: BID is the \$ amount of payment required in the dichotomous choice question;
SCOPE is the dummy for damage scenario;
ATT is a dummy set to 1 when the respondent indicated they favoured the environment more frequently than development when considering resource use project proposals); and,
VIS is a dummy set to 1 when the respondent expresses an intention to visit the area in the future.

The SCOPE dummy in the logit expression is highly significant with the expected sign. This is a result that strongly supports the hypothesis that the CV results are scope sensitive. Similarly the validity of the CV responses provided in the questionnaire is supported by the strong significance of the BID co-efficient. The negative sign is

⁵ The dichotomous choice variable that was used to form the dependent variable for this equation was unadjusted from the raw data. See Blamey, Bennett and Morrison (1997) for a description of models specified for variants of this variable that take into account protest responses.

consistent with expectations. The data indicate that respondents have been aware of the amount they have been asked to consider paying and reacted in a manner consistent with economic theory. The significance of the attitudinal variable (ATT)⁶ suggests that respondents have been consistent in their answers between a general, fairly standard survey question, and the more difficult CV question. Furthermore, the dummy variable relating to the presence of use value (VIS) is strongly significant and has a positive coefficient. This implies that people with an intention to visit the area are more likely to want the pipe built. These results are all supportive of the validity of the CVM results obtained.

The model indicates a median value for the protection of the Coorong and Tilley Swamp of approximately \$90 per person. This is approximately double the median value estimated for the protection of Tilley Swamp alone.

What the above logit expression does not indicate is that some variables which would, a priori, be expected to be significant were not. For instance, the insignificance of the STATE dummy is less supportive of the scope sensitivity hypothesis. The implication is that respondents' dichotomous choice answers are independent of their location. However, this is not sufficient evidence to reject the scope sensitivity hypothesis. A number of additional factors should be considered. It is possible for instance, that dichotomous choice responses were made primarily on the non-use values, such as existence value, supplied by the areas. Location would then be much less important. To some extent, this possibility can be explored by an analysis of use values for the area. If the rate of direct use of the area is different for South Australians than it is for NSW respondents, then it can be argued that there should be sensitivity to location. South Australians would have a use value component to supplement their non-use values that is larger than NSW respondents. To perform this exploration, data relating to the visitation of the area by respondents was cross-tabulated by state of residence. Both past visitation and expected visitation were correlated to state of residence. Not unexpectedly, South Australian respondents were more frequent visitors to the area. The significance of the VIS variable also contradicts the idea that only non-use values are important. Hence, the lack of sensitivity to distance must be regarded as a serious sticking point for the CV results.

However, it is still not sufficient evidence to reject the scope sensitivity hypothesis. Another confounding factor could be the different response rates that were recorded for SA and NSW. It is possible that more NSW resident respondents did not bother to return their questionnaires simply because they perceived the project to be irrelevant to them because of their location. By counting non-responses as "no" answers to the dichotomous choice question, location may become a significant factor. The only way to check this possibility is for non-respondents to be re-surveyed to check their reasons for failing to

⁶ There is some risk that the relationship between ATT and the dependant variable is spurious. ATT captures respondents views toward environmental issues in general whereas the dichotomous choice responses relate to one specific environmental issue. A high correlation between the two would be expected. In the absence of significant socio-economic independent variables, the attitudinal variable has been included.

return their questionnaires. This strategy is unavailable in the context of this study, but may be considered in future applications. In-person interviews or drop-off-pick-up questionnaire delivery modes would also help to avoid the problem.

Another variable which was not significant in the logit analysis of responses was respondent income.⁷ ⁸ The expected positive relationship between income and the willingness of respondents to agree to pay to avoid the environmental damage was not apparent.

To conclude the logit analysis, models were formulated for each of the damage scenario sub-samples. Comparisons between co-efficients in the pair of equations then provided a test for differences caused by the variation in damage scenario. The pair of equations is presented below:

$$\text{BASE:} \quad \log\{\text{pr}(\text{yes})/[1-\text{pr}(\text{yes})]\} = 0.25 - 0.012 \text{ BID} + 0.73 \text{ ATT} + 0.83 \text{ VIS} \\ (0.20) \quad (0.003) \quad (0.25) \quad (0.22)$$

(% correct prediction = 66.4%; -2 log likelihood = 470; N=376)

All the co-efficient estimates except the constant are significant at the 99% level.

$$\text{SCOPE:} \quad \log\{\text{pr}(\text{yes})/[1-\text{pr}(\text{yes})]\} = 0.77 - 0.01 \text{ BID} + 0.64 \text{ ATT} + 0.46 \text{ VIS} \\ (0.21) \quad (0.003) \quad (0.23) \quad (0.23)$$

(% correct prediction = 60.5%; -2 log likelihood = 438; N=365)

All the co-efficient estimates except the constant are significant at the 99% level.

The most immediately noticeable difference between the two equations is in the constant⁹. This is to be expected given the significance of the SCOPE dummy in the combined equation reported earlier and supports the scope sensitivity hypothesis. The estimates are approximately 2.6 standard errors apart. The BID and ATT co-efficient estimates are very similar. The BID co-efficients are only 0.67 of a standard error apart and the ATT co-efficients are 0.38 of a standard error apart.

⁷ Note that the attitudinal variable and income are not highly correlated. The inclusion of the income variable does not force the attitudinal variable into insignificance.

⁸ It is useful to note that in an alternative formulation of the dichotomous choice response data which accounts for protest expressions, income becomes significant at the 95% level. However, the co-efficient estimate is extremely small (0.032 ± 0.06). An analysis of those respondents excluded because of protest expressions showed a strong correlation with income. More higher income respondents were excluded from the analysis because of protest expressions than lower income respondents.

⁹ Note that there is some correlation between the VIS variable and the constant. The VIS co-efficient estimates are 1.68 standard errors apart.

4. Conclusions

For the results of any application of the CVM to be considered reliable, it has been concluded that sensitivity to the scope of the non-market good being considered should be established. The rationale for this conclusion is to ensure that the CVM has not been subject to "perfect embedding" whereby respondents answer the willingness to pay question as a venue for generating satisfaction from the act of supporting "a good cause". This potential has variously been described as the "good cause dump", a "moral free lunch", "the warm glow of giving" and "the purchase of moral satisfaction". Where the reason for "perfect embedding" is expanded to include other possible difficulties such as respondent unfamiliarity with the good, "perfect embedding" has also been called "part-whole" bias. Both proponents of and critics of CVM regard this potential -whatever it is called - as creating unreliable estimates.

"Perfect embedding" implies that the respondent's answer to a CVM question will be unaffected by the nature of the good involved. After all, the act of answering is what is hypothesised to be of value, not the quantity or quality of the good in question. The presence of "perfect embedding" will therefore be detected by an invariance of willingness to pay to the scope of the good.

A number of Australian applications of the CVM have tested the scope sensitivity hypothesis - some incidentally and some purposefully. The evidence of these tests is inconclusive. This is in contrast to the US evidence on scope sensitivity which more clearly, yet far from overwhelmingly, supports the contention that CV results are scope sensitive. To some degree, the reason for the Australian prevarication is that the studies carried out have had specific design problems that either have encouraged scope insensitivity or have made its detection difficult. However, the uncertainty regarding scope sensitivity has contributed to the uncertainty that Australian policy advisers and policy makers have shown in their willingness to use the CVM.

In order to help resolve the uncertainty regarding scope sensitivity in the Australian context, the CVM application reported here sought to test specifically for the problem. A research design was formulated that created two sub-samples of respondents differing only in terms of the information they were given regarding the good under consideration. That good was the prevention of environmental damage, resulting from the drainage of ground water from land affected by dryland salinity, to:

- a) Tilley Swamp (the base scenario); and,
- b) Tilley Swamp and the Coorong (the scope scenario).

A number of tests for scope sensitivity were undertaken. First it was shown that, overall, the proportion of respondents agreeing to support the proposal to prevent the environmental damage was significantly higher for the scope scenario than the base case. However, the strength of this support for the scope sensitivity hypothesis was somewhat weakened when the relationship between proportion agreeing and the damage scenario was considered for each of the bid values presented for the dichotomous choice

questioning format. Only for the two higher bids was there a significant difference between the two damage scenarios.

To determine if this initial test was caused by the action of other factors influencing respondents' decisions to agree to the proposal, a sequence of logit models explaining the dichotomous choice results were estimated. The variable in these expressions which captured the impact of scope variations across respondents was a dummy given the value one when the scope scenario was presented. In all models estimated, the scope dummy was significant at the 99% level of significance. This result, and follow-up results that showed differences between the intercept terms of the logit estimations of the individual damage scenario sub-samples, provide strong support for the hypothesis that the results reported are sensitive to scope variations. The range of logit estimations also showed strong relationships between the proportion agreeing to support the proposal and:

- the cost specified for the proposal;
- respondents' attitudes to the environment; and,
- respondents' intentions to visit.

The models estimated indicated a median value estimate for protection of the Coorong and Tilley Swamp of approximately \$90 per person. That estimate is approximately double the median value estimated for the protection of Tilley Swamp alone.

The only question mark raised over the scope sensitivity result is the absence of a significant income effect in the logit estimations and the insignificance of distance from the damage site as a factor affecting willingness to support the proposal. The latter result, gained from a comparison of NSW and SA respondents, may in part be explained by a lower response rate in the NSW sub-samples.

The strength of the results' responsiveness to scope must be regarded as a significant boost to the prospects of the CVM in Australian applications. The case study reported here demonstrates that a carefully designed CVM questionnaire can yield results that are internally consistent. The important message from this study to those contemplating the use of the method is that the phrase "carefully designed" implies considerable preparatory research before taking a questionnaire to the field. A three stage process for this preliminary work is recommended:

- a telephone survey;
- focus group discussion; and,
- pilot testing.

Too often in the past have CVM questionnaires gone into the field without adequate preparation. This has meant that respondents, on occasions, answered questions that they interpreted to have meanings very different from that intended.

Unfortunately, at least for the immediate future, the implication of this need for preliminary research is that the cost of applying the CVM will restrict its use to major resource allocation issues. In the longer term, it is conceivable that CVM practitioners will develop the skills needed to short cut the process. This will only come with consistent

application of the method over a wide range of circumstances. Such is the demand for non-market value estimates that this situation may arise over the next decade.

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