WTP and WTA in relation to irrigation development in the Fitzroy Basin, Queensland.

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Abstract:

Estimates of the compensating surplus generated by changes in non-marketed environmental amenities can be estimated using stated preference valuation techniques. These are typically framed in terms of WTP tradeoffs, even if the situation of interest involves a property right vestment that calls for a WTA question. The differences created by the two questioning formats are explored in this paper using the results of two choice modelling applications. Both applications were framed on the potential for irrigation development and environmental losses in the Fitzroy River Basin, Central Queensland. The scenarios used in the applications differed only in that they used alternatively WTP and WTA questioning formats. The results indicate that robust models could not be constructed from either WTP or WTA based data sets when only two alternatives were used in the choice sets. In contrast, a strongly fitting model was derived from WTP-based data where three alternatives formed the choice sets.

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1. Introduction.

Early applications of the contingent valuation method (CVM) demonstrated unexpected differences in estimates between willingness-to-pay (WTP) and willingness-to-accept (WTA) formats (Knetsch and Sinden 1984). There has been substantial debate about the causes of the disparity, and substantial effort has been applied at both a theoretical and experimental level to explain the differences (Mitchell and Carson 1989, Hanemann 1991, Horowitz and McConnell 2002). The experimental games pioneered by Kahneman (eg Kahneman et al 1992) involved participants being randomly assigned one of two low cost items, and then invited to trade items between them. The WTA of a participant to give up their good was strikingly higher than the WTP of other participants to purchase the good.

The ratio of WTA versus WTP prices has generally been found to be much higher[1] than economists would expect from the influence of income effects, or the combination of income and substitution effects when one item (eg an environmental asset) has no close substitutes (Hanemann 1991). Horowitz and McConnell (2002) review a number of WTA/WTP studies that have been conducted over the past 30 years, noting that high WTA/WTP ratios have been found across a wide range of goods. They note that the high ratios do not appear to be an artifact of stated preference or experimental situations. Repeating a given experiment with real money or incentive-compatible elicitation formats tends to generate just as high (or higher) ratios, and there is little evidence that ratios will fall as respondents become familiar with an experiment.

One consequence of the discrepency is that WTP measures for prospective changes have been recommended as the most appropriate format for stated preference studies, even if the purpose is to assess compensation amounts for losses (Arrow, Solow, Portney, Learner, Radner and Schumann 1993, Portney 1994). This may undervalue many potential environmental losses, where the appropriate measure of consumer welfare would be a WTA format (Knetsch 1990). A similar disparity may exist with property taken by eminant domain, where a WTA format would be a more appropriate measure of compensation than the WTP formats implicit in market values (Fischel 1994).

The issue about WTA and WTP formats can be illustrated with regard to water resources in Australia. In river systems where water is currently over-allocated for consumptive purposes, it is consistent to ask Australian (or State) taxpayers whether they are WTP to increase environmental flows within the river system. An implicit assumption is that irrigators and other water users hold property rights to the allocated water, and attempts to redress the situation will see some form of compensation flowing back to those who may lose water allocations.

In the Fitzroy basin in central Queensland, water resources have not been allocated to the maximum permissable level, given the reserves set by the state government to meet environmental needs[2]. The policy debate there is about whether to allocate more water

[1] Goldar and Misra (2001) note that WTA measures often exceed WTP by a ratio of 10:1 or higher.
[2] Most of these are set at the median flow levels under the Water Resources Plan for the Fitzroy.

for irrigation, given that there may be some environmental losses (as well as social gains). The policy situation in this case for the Australian (or state) taxpayer could be assessed in the WTA format. Will compensation from the increased development (in the form of jobs, economic growth and other factors) be enough to make the sacrifice of environmental assets worthwhile? However, if landholders and irrigators hold implicit property rights for further development, then a WTP format may be more appropriate. In this case, the taxpayers might be asked if they are willing to compensate landholders and irrigators for lost development opportunities in order to avoid further environmental losses.

Previous non-market valuation studies in the Fitzroy basin (van Bueren and Bennett 2000, Windle and Rolfe 2002, Rolfe et al 2002) have employed the recommended WTP format to estimate values for marginal changes in environmental and social conditions. In those Choice Modelling (CM) applications, respondents to a survey were told that with current trends, environmental and social losses would reach certain levels in 15 to 20 years time. They were then offered some alternative management strategies to provide for better environmental protection with offsetting costs in the form of higher taxes or rents. Thus a WTP format was used to estimate marginal values for further environmental losses in the basin.

The selection of the question format depends on which vestment of property rights is being modelled. The WTP format is consistent with landholders having rights for further water extraction and development, while the WTA format is consistent with the community (or the government) having the rights to further water extraction and development. This demarcation is rarely clear-cut in natural resource management issues. However, the thrust of the water reform process in Queensland has been to recognise private property rights over existing levels of water allocation and development, but to vest rights for further development with the government. This means that the WTA format may be more appropriate than the WTP format for assessing values associated with further development options.

The application of the CM technique to WTA measures is untested to our knowledge. One goal of the research presented in this paper is to develop a format that allows CM to be used in a WTA context. Furthermore, we are unaware of any rigorous comparison of values derived using CM in both WTP and WTA formats. Hence, a second goal is to estimate a WTA/WTP ratio. To do so requires consistency between the formats. CM has some potential strengths in exploring the WTA/WTP issue, because it allows the analyst an insight into how the various components of choices interact with each other. However, a 'tight' comparison involves a two-alternative format that is different to the more common three-alternative (or more) formats used in CM.

In this paper, these two goals are pursued. A CM experiment to estimate WTA/WTP ratios for environmental and social factors associated with irrigation development in the Fitzroy basin is reported. As an adjunct to the primary goals, a CM experiment to identify if the choice format (number of alternatives) has a significant impact on value estimation is reported. The paper is structured as follows. Theoretical issues are

discussed in the next section, and the design of the experiments is reported in section 3. The conduct of the experiments is reported in section 4, and results provided in section 5. Discussion and conclusions follow in the final two sections.

2. Theoretical issues

The challenge in designing CM experiments for comparative purposes is to minimise impacts of confounding factors. There are a number of steps in the application of a CM experiment where differences might potentially emerge. In a typical application, respondents are selected randomly and invited to complete a survey which includes a number of choice sets. Other components usually include some background and descriptive information to define the situation of interest to respondents, some framing questions to remind respondents about substitute and alternative goods, some debriefing questions to identify why particular choices might be made, and questions to collect demographic information (Bennett and Blamey 2001).

Choice sets are normally comprised of several alternatives, where each alternative is described by several attributes that can take different levels, and possibly by additional labels. The variation in levels and the use of labels creates differences between the alternatives. Participants make their preferred choice in each choice set, and in subsequent statistical analysis the most appropriate model to predict choices made is identified. Assumptions about consistent choice behaviour (necessary for modelling purposes) are met by having a constant alternative across choice sets. This can take the form of a 'no choice' option (Louviere 1988), and typically is associated with zero cost.

In applications to natural resource issues, it has become commonplace to describe the constant alternative in terms of some standard situation for the issue of interest (Bennett and Blamey 2001). This is normally the current situation, or the expected future situation if current trends continue. The other choice set alternatives then provide options for avoiding further losses from the current situation, or the extent of losses predicted under the future base, at some associated level of cost (and perhaps offsetting levels of some attributes). The use of a well-defined base in this way has advantages in terms of framing (clarifying to respondents what the tradeoffs are) and modelling (allowing values to be explicitly modelled in terms of marginal changes from some set level).

The output from a CM application are logit models that estimate the probability of a choice being made on the basis of the attributes involved and other factors, such as the characteristics of respondents. Values can be estimated by identifying tradeoffs between attributes and the monetary variables. For example, the marginal value of a change within a single attribute can be represented as a ratio of coefficients estimated in a logit model, as follows:

$$PW = -1 \times \beta_{attribute}/\beta_{money} \quad \text{... (1)}$$

Where PW is the part-worth (marginal value), $\beta_{attribute}$ refers to the coefficient estimated for an attribute, and β_{money} refers to the coefficient estimated for the monetary attribute. This part-worth formula effectively provides the marginal rate of substitution between income change and the attribute in question (Rolfe et al. 2000).

WTA versus WTP

To avoid confounding effects between WTA and WTP experiments, it is desirable to have the same attributes and levels to describe choice sets, as well as the same constant base. In the context of a natural resource management issue, it would be possible to set a base and then have WTA for changes in one direction and WTP for changes in another direction. This creates difficulties in assessing WTA and WTP difficulties. The expected diminishing marginal utility for larger quantities of a resource might be confounded with the WTA/WTP format.

Where a CM study is being designed to address a situation where rights are vested (albeit implicitly) to the impacted party but where a WTP format is to be used, a future base scenario is often employed. This communicates to survey participants the expected situation at a future time period. Participants are then asked through a series of choice sets if they are WTP to avoid that future scenario. Each choice set is typically comprised of the future scenario (which acts as a constant base) and two or more alternatives that come at some cost to respondents.

With the WTA format, it is possible to identify the current situation as the base, and then to identify different development alternatives with varying compensation levels for the environmental or other losses involved. However the results from this format are not directly comparable with the results from a WTP format using a future base. A format needs to be employed where the base is consistent across the WTA and WTP formats.

If the base in a WTP format is set at the current level of development and environmental condition, then the alternative choices involved in further development will involve further environmental or other losses, and be less attractive. The "trick" to using a WTP format with a current base is to ask respondents if they are WTP to maintain the current position. While this is feasible, it effectively restricts the choice sets to two options – the status quo (current base) and one alternative[3]. In the WTA format, respondents can be asked if they are willing to accept compensation for a single development option compared to the status quo base.

This format involving two alternatives, rather than the more frequently used three-or-more alternative format, allows the following hypothesis to be tested:

[3] This is because respondents can only be offered a single alternative for the status quo option that is being presented to them at a cost.

Ho: $PW_{WTA} = PW_{WTP}$
H1: $PW_{WTA} \neq PW_{WTP}$

where PW are the part-worths for changes that can be estimated from the models, and WTA and WTP are the relevant formats.

The number of alternatives presented.

A two-alternative design is needed to generate a 'tight' test between WTA and WTP formats. In contrast, many CM experiments involve three or more alternatives per choice set (Carson et al.1994). This raises questions about whether the two-alternative format impacts on respondent choices and subsequent model estimation compared three-or-more alternative formats. If the number of alternatives does impact on respondent choices, then there are implications for comparisons between dichotomous choice contingent valuation method (CVM) applications and the CM (multi-alternative) experiment results.

There is little evidence available to identify how the number of alternatives impacts on choice processes. Comparisons of CM and CVM formats are likely to involve implicitly such differences. Adamowicz et al. (1998) report a comparison experiment, but do not conclude that the different number of alternatives creates different results

This impact of varying the number of alternatives in CM can be tested with the following hypothesis:

Ho: $PW_{2ALT} = PW_{3ALT}$
H1: $PW_{2ALT} \neq PW_{3ALT}$

where PW are the part-worths for changes that can be estimated from the models, and 2ALT and 3ALT refer to the number of alternatives offered in the WTP models.

3. Design of the Experiments.

These issues have been reflected in the design and application of four split-samples of a CM experiment. The experiment was focused on the estimation of values for environmental and social impacts of further water resource development in the Fitzroy Basin of Queensland. The same attributes and levels were used across the four split-samples.

To test the first hypothesis, two of the split samples were focused on a direct comparison of WTA and WTP formats, where the only difference between the choice sets offered lay in the description of existing property rights and the payment mechanism. In the WTP format, participants were asked if they would pay to keep the status quo and avoid the losses involved in the alternative. In the WTA format, participants were asked if they

could be compensated for the losses involved in moving from the status quo to an alternative situation.

An experimental design was used to generate a set of profiles. These were blocked into two groups of 13 choice sets, so that there were two versions of each survey. The same choice sets were used in the WTA and the WTP formats. In the WTA version participants were offered a certain level of compensation for the environmental and social consequences of a development option, while in the WTP version they were asked to pay that dollar amount to avoid the same consequences of a development option. Examples of the choice sets are provided in Appendix 1 (WTA version) and Appendix 2 (WTP version).

To test the second hypothesis, a third and fourth split-samples were run with two and three alternatives respectively. In both cases, the constant base used was a future scenario, reflecting the expected levels of environmental and social attributes in twenty years time based on current trends. The alternative(s) offered provided a potential improvement that came with a cost tradeoff. Examples of the choice sets are provided in Appendix 3 (2 alternative version) and Appendix 4 (3 alternative version).

The same experimental design used in the first two split samples was employed for the third split-sample. For the fourth split-sample, an additional set of profiles was generated for the experimental design. In an effort to keep the choice task constant across the split samples, the experimental design was blocked into three version (with one choice set dropped). This meant that respondents for this split-sample completed eight choice sets. The experimental process is set out in Table 1, and the attributes and levels used are set out in Table 2.

Table 1. Design of the split sample experiments.

Hypothesis	Split sample	Format	Base	Alternatives per choice set (including base)	Number of versions	No of Choice Sets per version
A	1	WTA	Current situation	2	2	13
	2	WTP	Current situation	2	2	13
B	3	WTP	Future situation	2	2	13
	4	WTP	Future situation	3	3	8

Table 2. Attributes and levels used in the surveys.

Split sample	Alternative	Payment vehicle	Healthy vegetation left in floodplains	Kilometers of healthy waterways	People leaving country areas each year	Amount of water left in reserve
1	Current Base	$0	40%	1700	30	15%
	Alt 1	$20, $50, $100	25%, 30%, 35%	1200, 1400, 1600	5, 15, 25	4%, 8%, 12%
2	Current Base	$20, $50, $100	40%	1700	30	15%
	Alt 1	$0	25%, 30%, 35%	1200, 1400, 1600	5, 15, 25	4%, 8%, 12%
3	Future Base	$0	20%	1100	0	0%
	Alt 1	$20, $50, $100	25%, 30%, 35%	1200, 1400, 1600	5, 15, 25	4%, 8%, 12%
4	Future Base	$0	20%	1100	0	0%
	Alt 1	$20, $50, $100	25%, 30%, 35%	1200, 1400, 1600	5, 15, 25	4%, 8%, 12%
	Alt 2					

4. Conduct of the experiments.

A drop-off and pick-up approach was used to collect the surveys. Respondents were sampled at random in Brisbane based on a cluster sampling technique. Nodes were chosen at random in the city, and then some selection rule was used to pick residences (e.g. every 3rd residence in every 5th street). Each survey collector was provided with a set of instructions about how to verbally introduce the survey. Collectors made a minimum of two attempts to collect the survey. The surveys were collected in May and June 2002.

Table 3. Socio-economic characteristics of sample respondents.

Split sample	1	2	3	4	Average
Average age	39.69	40.98	40.33	39.68	40.17
% male	43	40	35	36	38
% of households with children	72	75	77	69	73
% that are members of an environmental organisation	1	4	3	7	4
% that are associated with farming interests	10	15	11	11	12
% with a post-secondary education qualification	27	48	35	40	39
% that tend to favour protection of the environment over development	31	41	36	39	37
% that tend to favour development over protection of the environment	6	2	5	5	5
Average income	$31,090	$48,190	$39,520	$39,870	$40,060

In Brisbane, 671 households were invited to complete the survey, and 391 surveys were completed. 58.3% of all people approached gave back a fully completed survey. 26.5% of all

people approached declined to complete the survey, and 15.2% of people approached took a survey form and either did not return it to the collector or did not complete it fully. Socio-economic characteristics of the different sample groups are presented in Table 3. One-way Anova tests revealed a significant difference in income between split-sample groups 1 and 2. There were no other significant differences identified between any of the sample groups.

5. Analysis of results

The results from the surveys were analysed with the Limdep software package. In the choice sets, respondents were given a "Not sure" category to indicate uncertainty as well as the alternatives set out in the choice set. The "Not sure" responses were coded to the "No pay" options in each choice set. In the initial comparison between the surveys, simple multinomial logit (MNL) models were applied. These models relate the choices made to the levels of each attribute in the choice sets, together with a constant value (the ASC) to capture the influence of other factors. The results of the models across the four split samples are shown in Table 4.

The results demonstrate that the models estimated for the three two-alternative choice sets[4] are particularly poor fits of the data. In contrast, a highly significant model was established for the three-alternative model. In the latter case, the chi-square statistic for model significance is high, and most attributes are significant and signed as expected.

Table 4. Simple MNL models for each survey

	Hypothesis A				Hypothesis B			
	WTA 2 Alternative, Current Base		WTP 2 Alternative, Current Base		WTP 2 Alternative, Future Base		WTP 3 Alternative, Future Base	
	Coeffic.	Standard Error	Coeffic.	Standard Error	Coeffic.	Standard Error	Coefficient	Standard Error
Rates	-0.004*	0.002	0.000	0.002	0.001	0.002	-0.015***	0.002
Vegetation	0.006	0.016	0.004	0.014	0.003	0.014	0.056***	0.014
Water	0.000	0.000	0.000	0.000	0.000	0.000	0.001**	0.000
People	0.005	0.008	0.004	0.007	-0.002	0.007	-0.010	0.007
Reserve	0.004	0.020	0.009	0.018	0.006	0.018	0.110***	0.018
Constant	-0.624**	0.305	-0.313	0.273	0.268	0.326	0.870**	0.216
Model Statistics								
N (Choice Sets)	1102		1274		1261		888	
Log L	-717.39		-879.12		-870.50		-859.48	
Adj. rho-square	0.05567		-0.00024		0.00069		0.11602	
Chi-square (DoF=5)	4.52		0.64875		0.54047		133.45	

*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

[4] For the two-alternative data sets, the omission of the "Not sure" responses and responses from respondents who were "confused" did little to improve model fits. The inclusion of socio-economic or attitudinal data also did not improve model fits.

Hypothesis A: WTA versus WTP

The models that have been estimated do not allow the first hypothesis to be tested. This is because there are not enough significant variables in each of the models to calculate part-worths.

Some evidence about the preferences between WTA and WTP formats can be gained by analysing the choices that were made in split-samples 1 and 2. In each survey version, the profiles for each choice number were exactly the same with the status quo constant base, except that the payment was compensation for development in the WTA version, and payment to retain the status quo in the WTP version. In both versions, there would be a cost in retaining the status quo position. In the WTA version this was the opportunity cost of missing out on compensation, while in the WTP version it was the direct cost of higher rates. In contrast, there would be a financial advantage in accepting the development option under both formats. In the WTA version this was the direct compensation that was offered, while in the WTP version it was the avoidance of increased rates.

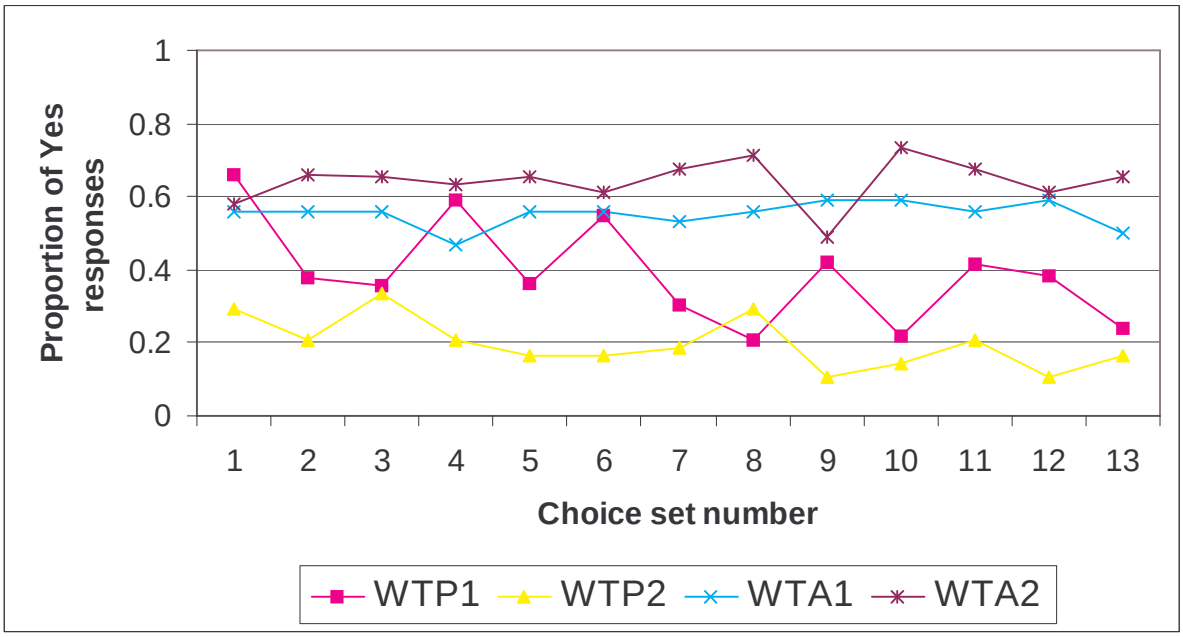
The proportion of respondents who chose Alternative A (the status quo) in each of the survey versions is shown below in Figure 1. Two key conclusions can be drawn. First, there is a significant difference between the 2Alternative-WTA and 2Alternative-WTP versions in the proportion of respondents choosing to maintain the status quo position. In the WTA version, the status quo option was chosen in 59.7% of choice sets, while in the WTP version, the status quo option was chosen in 29.5% of choice sets. A summary of a paired sample t-test comparing the proportion of responses for Alternatives A and B is reported in Table 5. The test is repeated across the two different versions of the survey. Results confirm that the different formats give rise to very different response structures.

Table 5. Paired Samples T-Test

	WTA – WTP Paired Differences				t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	Version 1	-.30220	.18514	3.6309E-02	-8.323	25	.000
Pair 2	Version 2	.19510	.13698	2.6865E-02	7.262	25	.000

Second, in order to protect the status quo option, respondents were more likely to sacrifice WTA compensation than to incur direct costs under the WTP format. This implies that losses from that status quo position will require larger amounts of compensation than corresponding WTP to move back to the status quo position. This is consistent with the bulk of research findings that WTA amounts are larger than WTP amounts for the same changes.

Figure 1. Proportion of responses for Alternative A in each choice set (Samples 1 & 2)



Respondents in the WTA survey were questioned about why they may not have chosen the development option at all. Of the 84 respondents, 9 of them (10%) indicated that they did not think it was right to accept money for environmental losses, while a further 16 (19%) indicated that they did not believe the government would ever give them a rebate. These responses suggest that ethical and payment vehicle differences between WTA and WTP formats may help to explain responses.

Hypothesis B: Two-alternative versus three-alternative formats

The models reported in Table 4 reveal that the hypothesis can not be directly tested. This is because there are no significant attributes for the two-alternative model, which does not allow part-worth values to be calculated. In contrast, well-fitting models can be estimated from the three-alternative choice data.

An expanded model for the three-alternative split sample data including socio-economic and attitudinal variables is reported in Table 6. This shows a strong model, with significant explanatory variables. For example, the likelihood of choice is increased if there are larger amounts of *Vegetation* and *Waterways* protected, and more water isheld in *Reserve*. As expected, increases in *Rates* or *People Leaving* were negatively associated with choice.

Respondents who thought that *The condition of the environment had declined over the past decade*, thought the survey was *biased to the environment*, or that they *Needed more information* were more likely to choose a protection alternative. Respondents who thought that they did not *Understand the information* in the survey were also more likely to choose a protection alternative.

Respondents who were older, female, had higher education levels, and/or higher income levels were more likely to choose a protection option.

Table 6. MNL model for 3 alternative survey format

	Coefficient	Standard.Error
Rates	-0.020***	0.002
Vegetation	0.058***	0.016
Waterways	0.001**	0.000
People leaving	-0.021***	0.007
Reserve	0.097***	0.019
Constant	-4.452***	0.785
Thought env. Declined	0.679***	0.188
Understood information	-1.360***	0.129
Needed more information	0.414***	0.102
Biased to the environment	0.757***	0.123
Age	0.020***	0.007
Gender	0.484***	0.182
Education	0.354***	0.082
Income	0.000***	0.000
Model Statistics		
N (Choice Sets)	864	
Log L	-693.76	
Adj. rho-square	0.26314	
Chi-square (DoF=23)	469.42	

*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Value estimation from a CM experiment can be demonstrated with the calculation of part-worth values. These give the approximate value of a one-unit change in the attributes used in the choice sets. The part-worths calculated from the three-alternative model are reported in Table 7. For example, the value of protecting an additional 1% of vegetation is $3.04 per household, while the value of protecting an additional kilometer of waterways is $0.05 per household.

Table 7. Part-worths from MNL model for 3 alternatives.

	Part- worth Vegetation	Part-worth Waterways	Part-worth People leaving	Part-worth Reserve
Estimated value	$ 3.04	$ 0.05	$ -1.09	$ 5.31
Lower CI	$ 1.40	$ 0.01	$ -1.99	$ 3.33
Upper CI	$ 4.91	$ 0.08	$ -0.51	$ 7.71

6. Discussion.

The key issue of interest is why the two-alternative models were so poorly fitting, while the three-alternative model had high explanatory power and significance. The split sample experiments

were consistent in the attributes and levels used (see table 2), in the information provided, in the presentation of the survey and in the collection process. As well, there is no significant difference between the characteristics of respondents for that split-sample group compared to the other split sample groups (Table 3). This means that the different response patterns are related to the structure of the surveys rather than to other factors.

An analysis of survey responses reveals a large proportion of "embedding" responses in the two-alternative experiments. In those experiments, respondents have tended to choose one alternative consistently, apparently unconcerned about differences between alternatives caused by changes in attribute levels. While there was some sensitivity to the levels of compensation in the WTA split-sample (as shown by the significant coefficient on the "rates" variable for the WTA 2alternative current base model in Table 4), there was no significant response to variations in the cost attribute in the other two-alternative models.

The pattern of embedding responses is shown below in Table 8. This shows that in the two-alternative experiments, a high proportion of respondents gave a consistent answer to the choice sets. In contrast, only a small proportion of respondents (3.6%) in the three-alternative experiment gave consistent responses. It is also notable that there were high proportions of "Can't choose" responses in the split-samples with the status quo base, suggesting that respondents may have found this format more difficult to comprehend and evaluate. There is also a difference in the rates of "Can't choose" responses between the two-alternative and three-alternative formats, indicating that providing more than two choice alternatives increased the ability of respondents to evaluate the different options.

Table 8. Uniform responses chosen.

Split-sample	Format	Number of uniform responses chosen				Total surveys collected	% of uniform responses
		Option A (Status quo)	Option B	Option C	Can't choose		
1	WTA- Current base	29	12		21	85	61.2
2	WTP- Current base	6	20		26	98	53.1
3	WTP- Future base	16	13		8	97	38.1
4	WTP- Future base - 3 Alt	4	0	0	0	112	3.6

Although Hypothesis B can not be directly tested, the evidence from the model results shows that the number of choice alternatives has a direct impact on respondent behaviour. The most direct evidence relates to the changes in response patterns as the number of alternatives offered to respondents vary. In testing hypothesis B, the only difference in the surveys was that respondents were offered 2 alternatives per choice set in split-sample 3 and 3 alternatives per choice set in split-sample 4. All other factors were held constant.

The provision of the third choice alternative has reduced the occurrence of uniform option (embedding) choices (see Table 8). This is the case for both the development and the status quo options, even though the additional alternative was only offered with the development option. Providing more than two alternatives has 'freed up' the choice behaviour of respondents. Conversely, offering only two alternatives seems to have locked respondents into fixed choice positions, where the underlying attributes of the choice options made little difference to the positions reached. It appears that offering only two alternatives caused respondents to focus on the labels or other key identification features (i.e. development or environment) rather than looking at the underlying attributes. It also made it more difficult for respondents to make choices, as shown by the rate of "Can't choose" responses.

This behaviour has remained hidden in most dichotomous choice situations, such as referendums or contingent valuation surveys. There are usually many alternatives to resource allocation problems, and it appears that condensing them to two alternatives creates particular difficulties for respondents. One reason is that respondents may be reluctant to make 'black and white' choices. Condensing issues down to two alternatives may create tradeoff dilemmas between ethical or moral issues that respondents find difficult to deal with (Fishbein and Ajzen 1975, Blamey 1998). Another reason is that the number of alternatives may influence preference construction in poorly understood ways, partly because respondents misunderstand or mistrust the options presented to them (Fischhoff et al. 1999). It appears that offering more than two alternatives may help.

7. Conclusions.

Two separate hypotheses have been tested in four split-sample applications of a CM experiment focused on valuing environmental and social impacts of further water resource development in the Fitzroy Basin of central Queensland. To avoid confounding effects and so allow comparative testing, almost all of the design, presentation and information components of the split-sample surveys were held constant.

The first hypothesis of interest related to whether values for environmental and social changes in the Fitzroy basin were substantially affected by the implicit allocation of property rights. A WTA and a WTP survey split were run to identify if the format caused substantial value differences. The results were inconclusive, because the two-alternative format used induced embedding responses that did not allow strong models of choice behaviour to be generated. However, a simple analysis of response rates confirms that the format affects respondent choices. In the WTA version, the status quo option (for environmental protection) was chosen in 59.7% of choice sets, while in the WTP version, the status quo option was chosen in 29.5% of choice sets, even though the choice sets were otherwise identical.

The second hypothesis of interest related to whether the number of alternatives presented in a choice set influences value estimation. Striking results were gained from running two survey splits where the only difference was that an additional protection option was offered in one of the split-samples. Embedding behaviour was observed in the responses to the two-alternative option, where most respondents were indifferent to changing levels of the tradeoffs involved, including the costs that they might bear. As well, there was a much higher rate of "Can't choose" responses in each of the two-alternative split-samples compared to the three-alternative one. This indicates that respondents found it easier to analyse and make choices in the three-alternative formats.

The implications of the results are that summarising complex situations to binary choice formats may hinder rather than help respondents to evaluate tradeoffs. There are a number of potential reasons for this, including those relating to perceptions about ethical tradeoffs, and the impact of hidden cues on preference construction. As well, these results imply that there may be methodological reasons why values may differ between CVM and CM applications. These are topics for further research. For practitioners of the CM technique, the results indicate that it is preferable to offer more than two alternatives in a choice set[5].

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[5] There are already some theoretical reasons for not using binary choice options, as it makes it impossible to test for IIA/IID violations.

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