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Public values for improved water security for domestic and environmental use

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Abstract

Developing metrics for evaluating environmental tradeoffs can be done with varying levels of consistency across case study sites. A key issue is to determine if standard evaluation experiments can be conducted over multiple sites or whether experiments have to be tailored to each case study application. To test the usefulness of a consistent approach, a choice modelling valuation exercise has been undertaken across several countries to assess the tradeoffs that households are prepared to make between water use restrictions, maintaining environmental condition in waterways, and increased water costs. The results from the Queensland survey are reported in this paper. The results indicate that it is not possible to downplay framing issues at the case study level, and that it is not appropriate to standardize applications across case studies with differing characteristics.

1. Introduction

Stated preference experiments to value environmental tradeoffs are costly to implement. In many situations a more feasible option is to apply non market values from secondary data sources to a case study target in a process known as benefit transfer (Desvousges et al. 1992; Boyle and Bergstrom 1992; Bateman et al. 2002; Rolfe and Bennett 2006). The development of stated preference techniques such as choice modelling (CM) has facilitated the use of benefit transfer values and functions because CM allows the expression of environmental values as a function of a number of site, population and other characteristics (Rolfe 2006). Most interest in the use of benefit transfer has been to identify if it is accurate to transfer values from a source study to a target site, with the evidence offering some conditional but not complete support (Brouwer 2000, Rolfe and Bennett 2006).

One of the problems facing practitioners is the limited pool of source valuation surveys, with little consistency in the way that data has been collected and modelled, and the brevity of reporting in many academic publications (Loomis and Rosenberger 2006). There has been developing interest in more systematic applications of stated preference experiments and value databases to facilitate benefit transfer (Morrison and Bennett 2004; van Bueren and Bennett 2004; Rolfe and Windle 2008). One of the main advantages in this approach is that it eliminates inconsistencies in survey instruments with different design dimensions (Caussade et al. 2005; Hensher 2006; Hensher et al. 2007) and across a range of framing and valuation scenarios (Rolfe and Windle 2008).

The potential application of environmental values as metric weights in evaluation or funding programs raises questions about how those values can be sourced. Some forms of benefit transfer are likely to be appropriate, but evaluation programs, such as the Conservation Reserve Program in the United States, tend to be reasonably uniform in application across various jurisdictions. This suggests that there may be demands for values to be uniformly derived across different case studies to facilitate application into different programs as metric weights.

A potential way of facilitating benefit transfer applications is to standardise the choice experiments between potential source and target frameworks, even across different international contexts. This should provide evidence about the extent to which values are directly transferable, unhindered by concerns about variations in attributes, methodology or collection techniques. Many split sample experiments (e.g. Morrison and Bennett 2004) operate by framing different case study issues into the same format so that parallel choice experiments can be performed.

This paper reports a comparative study that has been undertaken in an international and transcontinental context to test survey transferability for benefit transfer applications. The results help to identify whether a uniform approach to estimating metric weights is likely to be appropriate. A choice modelling survey, framed in the context of increasing water scarcity and competing water uses, was developed in Australia to be consistent with a larger European study. The choice section was designed to assess the tradeoffs households make between the frequency of restrictions on domestic outdoor water use and the environmental condition of rivers as water flows are reduced. Replication in an Australian case study involving Rockhampton residents in central Queensland provided some evidence about the extent to which the survey approach was transferable outside of a European context.

The survey instrument was designed for implementation in a number of different European countries which meant a relatively simple format was required to facilitate translation and transference across different contexts. One of the main issues of concern was the need for consistency between case study applications which meant the survey was largely maintained in a standard format rather than being specifically tailored to suit local conditions. The Rockhampton results suggest there were two main areas where survey transference impinged on reliability. These focused on the framing of the relevant issues into the choice scenarios, and the simplicity of the tradeoffs that were offered to respondents. In this case study:

- The way in which the choice scenarios were framed was less than ideal in order to make it compatible with overseas studies.
- The choice sets were very simplistic and described in terms of a small number of attributes and levels. This made it hard to capture the essence of the real world problem.

In this paper, the results of the Rockhampton survey are presented and the two main transference concerns are discussed. The paper is ordered as follows. In the next section a brief background is provided about water use and availability in the Rockhampton area. The third section provides details of the design of the choice experiments and the results are presented in the following section. The results are discussed in the fifth section and conclusions drawn in the final section.

2. Water scarcity and the Rockhampton case study area

In Rockhampton, the Fitzroy river runs through the middle of the city. The river is a large and prominent feature of the town and is popular for a range of recreational activities. There are a number of water related issues that may be of interest to local residents, such as:

- water availability for household use;
- environmental use (environmental flows);
- water availability for industrial and agricultural use (economic development);
- recreational use; and
- water quality.

The valuation scenario in this research project addressed the first two issues. Framed in the context of growing water scarcity, respondents were asked to make tradeoffs between two potentially competing demands for water use – household demand for outside domestic water use and the environmental need for water to remain in the river system to protect ecosystem health. A stated preference valuation technique was an appropriate method to apply as the importance households attach to these natural resource management issues incorporate a mixture of both use and non-use values (Windle and Rolfe 2005).

Rockhampton is located on the Tropic of Capricorn and is subject to seasonal variation in rainfall as well as being subject to extreme episodic weather events. This means residents are familiar with periodic changes in water levels and flows. The survey was conducted in 2008 and earlier in the year the river had twice flooded parts of the city. Unlike some river systems in Australia, water in the Fitzroy basin has not been over-allocated and currently the demand for water use does not exceed the supply of water in the system. Current usage (including domestic use) accounts for about 35% of the water supply with a further 50% being allocated for environmental flows to maintain the environmental condition of the river system. This means that approximately 15% of the water flows are currently unallocated (Rolfe and Windle 2005).

These conditions have meant that even in years of drought there have not been serious water shortages in Rockhampton. Current domestic water restrictions on outside water use (in operation at the time of the survey) only limit the number of sprinklers in use at any time to one. In previous drought years, higher level restrictions have limited the use of sprinklers to three days a week. These restrictions were not enforced and caused relatively little hardship. However, the issue of water scarcity and increasing problems of water availability in many other urban areas are well known to Rockhampton residents. In addition, there are increasing demands for Rockhampton water which could impact on water availability in the future. The recent coal mining boom in the Fitzroy basin has meant increased demand for water from the mining sector as well as fuelling rapid population growth. As well, there are plans for pipelines to supply other nearby urban areas such as the Capricorn Coast and Gladstone (QNRW 2008), and potential growth for irrigation. So while water restrictions not currently an issue in Rockhampton, it is reasonable to expect that future urban supplies may be more constrained.

Regular water flows in the Fitzroy basin also mean that the waterways are in reasonably good environmental condition. Recent environmental valuation surveys have suggested that 50% of the waterways in the Fitzroy basin are in good health (Rolfe and Windle 2008) and 75% the Fitzroy River estuary is currently in good condition (Windle and Rolfe 2005). Rockhampton is situated in the upper part of the river estuary.

3. The choice modelling survey design

The CM technique requires respondents in a survey format to choose a single preferred option from a set of a number of resource use options (Bennett and Blamey 2001). The economic theory underlying CM assumes that the most preferred option yields the highest utility for the respondent (Louviere et al. 2000; Bennett and Blamey 2001). The options presented to respondents use a common set of underlying attributes that vary across a set number of levels. The variation in the levels of attributes differentiates the options to respondents. By offering the combinations of attributes and levels in a systematic way through the use of an experimental design (Louviere et al. 2000), the key influences on choice can be identified (Rolfe 2006).

The CM survey in this study was a translated version from a sister study conducted across European countries. As the sister study had already been designed, the survey was applied to the Australian case study with only minor changes. One of the first issues of concern in the transferability of the survey was whether the background information used to frame the choice scenarios remained sufficiently realistic and relevant in the Rockhampton context. This is discussed in the following section.

3.1 Background information and framing issues

In the choice section of the survey, respondents were asked to indicate their preferences for different tradeoffs between three primary attributes:

- frequency of restrictions on domestic outdoor water use;
- the environmental condition of the waterways; and
- an additional cost in their water bills.

The status quo or base level option described the situation that currently existed with improvements possible (with an associated cost) within a 10 year time frame.

The base level for **water restrictions** was a frequency of 4 in every 10 years, with potential improvements reducing this to 1, 2 or 3 years. Respondents were provided with the following information, which matched the information in the European surveys:

> I would like you to assume as a household you currently face a likelihood of water use restrictions during 4 of the next 10 years until and including 2018 based on the predictions of climate change experts. This means that during the next 10 years you will face <u>outdoor</u> water use restrictions in 4 different years. That is, you may not be able to water your garden, wash your car or fill your swimming pool during certain days in some months in those years. This water shortfall can last up to 20 days with water use restrictions in place during the day for up to 6-7 hours. Depending on the water saving measures, the likelihood of outdoor water use restrictions during any one period over the next 10 years can be reduced to 3 years, 2 years or 1 year.

There was some degree of ambiguity in this description over the period of restrictions and the type of water saving measures, so it is possible that not all respondents believed the information. Nonetheless, the basic scenario of an increase in the likelihood of water restrictions was consistent with future scenarios in the Fitzroy basin and some community perceptions. However, there were two potential elements in this description that did not fully suit local conditions:

- The severity of water restrictions was relatively mild and would cause little inconvenience. In particular, they were less severe than respondents may have already experienced.
- The improvements in the frequency of restriction were relatively small.

The other principal attribute used in the survey was **environmental condition,** with the base level or current situation being waterways in poor condition. The following attribute level descriptions were provided.

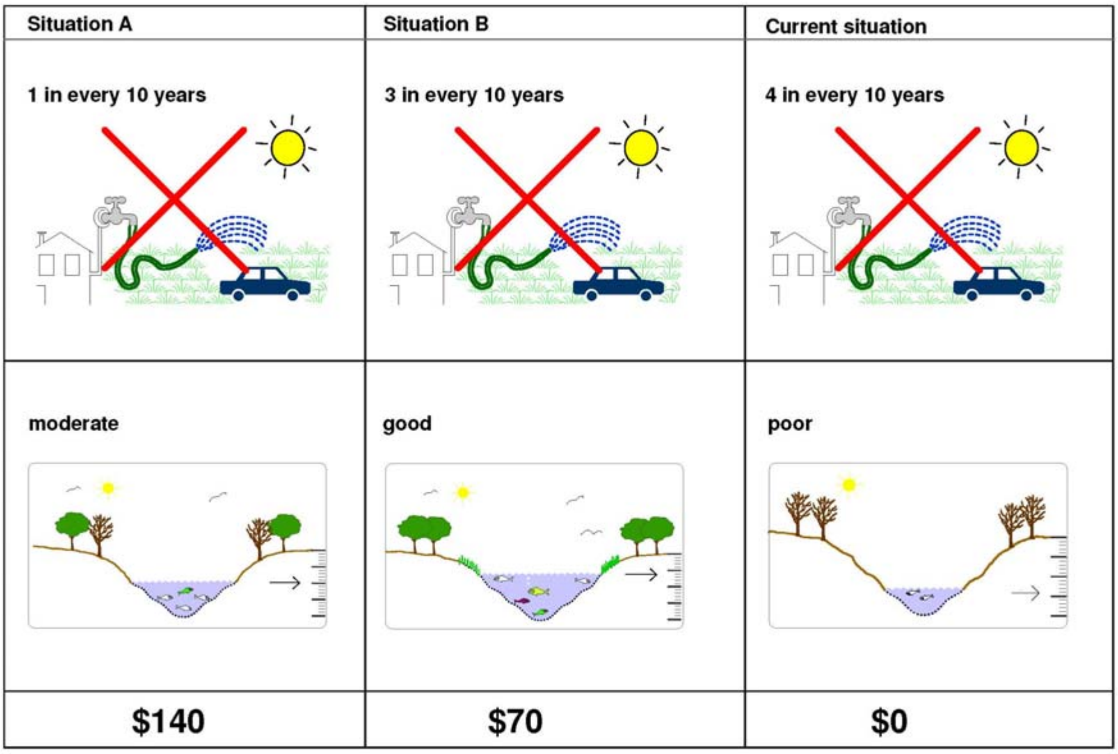
  - **Poor**: This is the **potential** future situation of low water levels and low environmental quality. There is a LARGE gap between the poor and natural situation due to increased water scarcity and climate impacts. Many fish species have disappeared and riverbanks have lost much of their vegetation. As a result many birds have disappeared too.
  - **Moderate**: less than average water levels and environmental quality. There is a SUBSTANTIAL gap between the moderate and natural situation. A limited number of fish species are present. Riverbanks have some vegetation supporting a limited number and variety of birds and other wildlife.
  - **Good**: water levels and environmental quality are close to their average natural levels. There is a SMALL gap between the good and natural situation. In the good situation riverbanks have a lighter than natural vegetation cover. As a result the breeding and nesting conditions for some birds are still limited.
  - **Very good**: water levels and environmental quality are in their natural state. There is NO gap between the very good and natural situation. Conditions for wildlife are optimal.

In many parts of the Fitzroy basin the waterways are in good health as indicated in the previous section and a more realistic base level would have been a “moderate” condition. However, in the Rockhampton area there are many degraded parts of the river system and a baseline condition of “poor” condition was not totally unrealistic. The other issue that does not totally suit local conditions is that lower water levels were associated in the survey with lower levels of environmental condition. In Rockhampton, fluctuating water levels are part of the natural condition.

3.2 Choice simplicity

To minimise any transference bias the choice sets were kept relatively simple and a limited number of choice sets, attributes and alternatives were used in each choice set. This would reduce choice complexity, but there may have been a tradeoff in terms of making the choice sets realistic (Rolfe and Bennett 2008). Respondents were presented with four choice sets, with three alternatives, described in terms of the three attributes in each set (Figure 1). The design of the choice card was very simplistic and could have sent a signal to respondents that the choice tradeoffs were simple and need not be given serious consideration.

Figure 1. Example choice card



4. Survey results

Three hundred surveys were collected from Rockhampton residents in September 2008 using a direct interview approach. Households were approached at random by selecting a number of different streets in the city and then inviting a proportion of households on each street to participate. Only residents who had lived in the town for more than ten years were asked to participate in the survey, with an initial screening question used to identify those residents[1]. The response rate to the survey was 73% with 28 households (9% of the final sample) recorded as ineligible as they had lived in Rockhampton for less than the 10 year minimum required.

The socio-demographic characteristics of the survey sample closely matched those of the population in most categories (Table 1). There were statistically fewer single person dwellings included in the survey sample compared with the population which meant the average household size was higher in the sample. There were also more women and more respondents with higher education levels in the sample compared with the population.

Table 1. Socio-demographic characteristics for the sample and population

	Sample statistics	**Population statistics[1]**
Average age (range 18-91 years)	48 years	46 years
% female	59%	50%
Average household size	2.9	2.5
Households with children under 18 living at home	40%	-
Education:		
% with non-school qualification	47%	39%
% with tertiary education	24%	19%
Employment:		
% employed	65%	61%
% unemployed	3%	3%
% not in workforce	32%	35%
Average annual household income (gross)	$59,556	$56,836

[1] Australian Bureau of Statistics 2006 Census

Respondents were asked a number of general questions to gauge their attitudes to water scarcity and environmental condition of the waterways in the Fitzroy basin as well as their experience with water use restrictions. The sample statistics are outlined below and indicate that:

Recreational use and attitudinal responses

- 55% undertook some recreational activity near open freshwater with 73% indicating usage at monthly intervals;
- 54% did not consider water availability/supply was a problem and only 11% thought it was a “big” problem;
- 62% did believe the environment was affected by water availability in the Fitzroy basin;

[1] The purpose of this allow questions about historical use and experience to be included in the survey.

- 70% agreed and 18% disagreed that "*the environment has the right to be protected irrespective of costs*"; and
- 38% agreed and 48% disagreed that "*water scarcity is a natural phenomenon beyond human control*".
- When water is scarce, average ranking score (from 1(highest priority) to 3) for water priority after households:
    - Agriculture = 1.4
    - Environment = 1.9
    - Industry = 2.6

Experience with water restrictions

- 59% indicated they never experienced water restrictions;
- 22% indicated they had experienced water restrictions in every one to four years and 16% indicated they experienced restrictions in every five to ten years; and
- 64% believed they would face restrictions in the future with an average expected occurrence of one in every 4.4 years.

Credibility

- 59% thought it was credible that water scarcity will increase in the Fitzroy basin in the next 10 years and only 13% thought it was not credible; and
- only 12% of respondent indicated that they thought the choice alternatives were not credible.

Half the respondents used freshwater areas for recreational use. There is a significant correlation (Pearson's chi squared crosstab significant at 5%) between recreational users and respondents who believed that water availability/supply does affect the environmental condition of the waterways. The majority of respondents believed in the right of the environment to be protected.

However, the results indicate that water availability/supply is not considered a major issue in the Fitzroy basin and in times of water shortages more respondents thought agriculture should be given higher priority for limited water than the environment. The results also indicate that the majority of respondents have not experienced water restrictions although most people did expect to in the future. In reality, there have been water restrictions in Rockhampton, as indicated in the previous section, but these restrictions were relatively minor, were not enforced and resulted in minimal inconvenience, which is why many respondents appear unaware that they existed.

4.1 Choice modelling results

The random utility approach underlying the CM technique provides the theoretical basis for integrating choice behaviour with economic valuation. Logistic regression techniques are normally employed to analyse choice data. The resulting statistical model predicts choice behaviour as a function of the attributes and that identify the different choice sets, as well as the characteristics of respondents (Rolfe 2006).

Random utility models are used to describe the utility of each choice selection in terms of a deterministic component and a random error component. The deterministic component accounts for the observed and explainable elements of respondents' choice behaviour, while the error component is used to capture any unexplained or unobserved variations in choice behaviour (Louviere et al. 2000). Assumptions about the distribution of the random error term underlie the statistical models generated from the choice data (Hensher et al. 2005; Rolfe 2006).

The multinomial logit (MNL) model (McFadden 1974) has formed the basis of choice analysis and is one of the most popular choice models in use (Hensher et al. 2005). A more useful framework in the application of choice modelling is the conditional logit (CL) model, where there is greater scope to identify differences between choice alternatives. This is particularly useful when a constant base or status quo option is part of the choice sets, because many attribute levels may be conditional on a choice alternative being selected (Rolfe 2006). The assumptions implicit in the use of the MNL and the CL models impose a restriction known as the Independence from Irrelevant Alternatives (IIA) condition. This states that the probability of a particular alternative being selected is independent of the other alternatives, and has an underlying condition that the error terms are independently and identically distributed (IID) with a (type I) extreme value distribution.

CL models are known to be subject to violations of the IIA assumption (Johnson et al. 2000). Concerns about these behavioural limitations and significant advances in simulation methods have led to increased use of a mixed logit (ML) or random parameters logit models (Hensher et al. 2005). ML models provide a more detailed analysis of preference heterogeneity and have three main advantages over the CL model (Train 2003).

1. ML models have unrestricted substitution patterns as the restrictive IIA assumption is relaxed. Preference heterogeneity and correlation across alternatives is taken into account.
2. In CL models, single parameter coefficients are calculated across all respondents. In ML models, the parameter coefficients associated with each observed variable can vary randomly across respondents. A probability density function can be calculated for each individual, which provides information about the mean and spread of parameter coefficients. A number of different distributional forms may be specified.
3. ML models allow for correlations amongst panel observations. In CL models, an individual responding to four choice sets is counted as four separate individuals.

In this CM valuation experiment respondent's choice preferences were analysed and explained in applications of both CL and ML models. The attribute levels and description of the different variables used in the choice models are outlined in Table 2.

Table 2. Variables and coding details used in the choice models

Variable name	Description	Codes/levels
ENV_COND	Environmental condition	poor (base); moderate; good; very good
WAT_RESTR	Water restrictions	4 in every 10 yrs (base) ; 3 in every 10 yrs; 2 in every 10 yrs; 1 in every 10 yrs;
COST	Annual payment for 10 yrs	$0 (base) $35; $70; $105; $140; $175; $210
ASC1	Alternative 1 specific constant	
ASC2	Alternative 2 specific constant	
GENDER	Gender	0=male; 1=female
AGE	Age	Actual age
CHILDREN	Children under18 yrs living at home	0=not present;1=present
EDUCATION	Education categories	0=no formal eduction to 4= tertiary and above
INCOME	Gross household income – categories	1=less than $10,000 to 10=more than $90,000

A CL model was first calculated as a base from which further improvements were trialled and developed. The results are presented in Table 3.

Table 3. Baseline conditional logit (CL) model

Variable	Coefficient	Standard Error
ASC1	0.8182	0.6668
COST	-0.0092***	0.0014
WAT_RESTR	0.0172	0.0494
ENV_COND	0.6897***	0.0571
ASC2	0.9421	0.6706
GENDER	-0.5851***	0.2248
AGE	0.0102	0.0073
CHILDREN	-0.8055***	0.2876
EDUCATION	-0.0206	0.1358
INCOME	-0.00001**	0.000003
Model statistics		
Number of observations	1172	
Log likelihood function	-958.9667	
R-squared adj (constants only)	0.1037	
Chi sqrd (8)	231.1037	

*** Significant at 1%; ** Significant at 5%; * Significant at 10%;

The model is statistically significant, with both the cost and environmental condition attributes highly significant and signed as expected. However, the water restriction attribute is not significant. Other notable features of the model include:

- The ASCs associated with each alternative are not significant, implying that the selected variables sufficiently account for choice selection.
- The income variable is significant, indicating respondents were price sensitive. However, contrary to expectation, the negative sign implies people with higher income levels were less likely to select the improvement option.
- The education variable is not significant and remains so even when recoded into a dummy variable for those with post-school qualification or not, as well as for those with or tertiary education or not. This implies that the over-selection in the sample towards higher education levels is not having any notable impact on choice selection.
- Females and households with children living at home were less likely to select the status quo option.

Analysing the data with ML models provides more detailed information about preference heterogeneity. The following steps were taken before the final model was calculated (Table 4).

- Attempts to randomise (with a normal distribution) the water restriction attribute resulted in it remaining non significant, so it was not included as a random variable in the final model. However, when included as a random variable, the derived standard deviation of the parameter distribution was significant. This highlights the preference heterogeneity amongst respondents and that some people had positive preferences while others had negative preferences for water restrictions.
- The number of halton draws was systematically increased until the model statistics (log likelihood value and R squared values) indicated the model fit was declining. A maximum fit was achieved with 35 draws.
- Repeated choice observations for each individual were treated as panel data with each respondent facing four choice scenarios.

The ML model is significant and has a much stronger fit than the base CL model presented in Table 3, with the adjusted R squared value increasing from 0.1037 to 0.3785. All variables are signed as expected a priori. However, in this model, unlike the CL model, both the ASCs associated with each alternative are significant, implying that factors other than those included in the model were influencing choice selection. The model results indicate:

- The derived standard deviation parameter distribution (normal) for environmental condition is significant which indicates there is preference heterogeneity within the sample population.
- Gender and Income are the only significant socio-demographic variables.

Table 4. Mixed logit (ML) model

Variable	Coefficient	Standard Error
Random parameters in utility functions		
ENV_COND	1.1211***	0.1519
Non random parameters in utility functions		
ASC1	2.4137*	1.2817
COST	-0.0173***	0.0023
WAT_RESTR	-0.0310	0.0645
ASC2	2.4376*	1.2863
GENDER	-0.7850*	0.4227
AGE	0.0011	0.0141
CHILDREN	-0.5064	0.4859
EDUC	-0.1333	0.2642
INCOME	-0.00001**	0.00001
Derived standard deviations of parameter distributions		
Ns ENV_COND	1.9769***	0.1894
Model statistics		
Number of observations	1172	
Log likelihood function	-800.2754	
McFadden Pseudo R-squared	0.3785	
Fixed number of obsrvs/group	4	
Halton sequences	35	

*** Significant at 1%; ** Significant at 5%; * Significant at 10%;

Three further adjustments were made to the ML model to gain a better understanding of the relationship between the variables. First, the socio-demographic variables were interacted with the random parameter to determine if there was any preference heterogeneity around the mean. None of the interactions were significant. Second the same variables were modelled to decompose the random parameter heteroscedasticity. This allows for a segmentation of the distribution of the random parameter and provides information about where different segments may lie on the distribution. Only the CHILDREN variable was significant and negative, indicating there is more variation in the preferences of respondents without children at home for improved ENVIRONMENTAL CONDITION. However, this is not a stable relationship and different combinations of socio-demographic and attitudinal variables produce different results with little overall consistency. Third, a model with both non-price choice attributes randomised was run that indicated there was no significant correlation between them.

In summary, the most robust statistical analysis would indicate that:

- preferences for improved environmental condition are highly significant but incorporate significant preference heterogeneity;

- the cost attribute is also significant and respondents are cost sensitive;
- the water restriction attribute is not significant but is associated with a range of both positive and negative preferences; and
- the socio-demographic variables are not consistent preference indicators.

Modelled preference information for the different attributes was supported by additional information provided by respondents in a follow up question after the choice sets had been completed. Respondents were asked to indicate the main reason driving their choice selection:

- 56% indicated they had a preference for environmental condition;
- 23% indicated cost was their major consideration; and
- only 9% indicated the main reason for their choice was focused on water restrictions.

5. Discussion

One of the main issues of concern with the results is that the water restriction attribute is not significant although this would normally be an important issue for some households. As there were only two primary attributes in the choice set, the fact that one of them was not a significant influence on choice selection critically undermines the validity of the valuation exercise. There are at least two potential reasons why the attribute was not significant, relating to information framing and choice simplicity.

5.1.1 Information framing

It was possible that the information about restrictions was not relevant to respondents in Australia as the low level of severity might mean the suggested restrictions would not be considered a serious inconvenience. Restrictions on outside water use were only to apply to on certain days (for part of the day) in certain months and could only last for up to 20 days. In comparison, a similar choice modelling valuation recently conducted in south east Queensland by Blamey and Bell (2007) described the water restrictions in more severe terms. Their valuation was framed in the context of tradeoffs between the frequency and duration of water restrictions (separate attributes) as well as the appearance of public lawns, parks and sports grounds. In their choice scenario, respondents faced level 4 restrictions which meant households could not use hoses or sprinklers and were only permitted to water gardens and wash cars using **buckets** before 8am in the morning and after 4pm in the afternoon - on three days of the week. Filling or topping up swimming pools was only permitted if households introduced a minimum of three other approved water conservation measures. The Blamey and Bell survey also used a much higher range for the frequency of restrictions (from once every four years to once every 100 years).

It was also possible that the information was not realistic to respondents. It was expected that some respondents would select the status quo option because they did not think the choice scenarios were credible or convincing. However, there was a relatively low proportion of status quo options selected across the whole survey sample. In 89% of cases, the status quo option was never selected and in only 6% of cases was it selected in each choice card. This meant that even though the information framing did not completely match local circumstances, respondents accepted the overall valuation scenario where there is growing pressure on limited water resources and tradeoffs between environmental and domestic uses will occur.

5.1.2 Choice simplicity

The choice set was contextually and visually simplistic. Framing the scenarios in this way made it easier to be consistent across different case studies, but had a tradeoff in terms of loss of realism. It is possible that the simplistic scenarios did not map well to respondents' understanding of water issues, thus helping to explain the lack of identifiable patterns in some choice data. However, there were a number of factors that suggest that respondents did consider the choice questions seriously, such as:

- respondents were price sensitive – the cost attribute was significant;
- there were a low number of status quo responses;
- the majority of respondents (59%) thought it was credible that water scarcity would increase in the future (Section 4); and
- only 12% of respondents thought the choice alternatives were not credible (Section 4).

Alternatively respondents may have considered water restrictions as important, but still have attached more importance to environmental condition. Other water related issues would also have been important to respondents such as water quality and recreation use. Indeed, there was a significant correlation between respondents who used freshwater areas for recreational purposes and those who thought the environment in the Fitzroy basin was affected by water availability (Pearson's chi squared crosstab significant at 5%). It is possible that concerns about other water issues were embedded (Carson and Mitchell 1995) into the environmental condition attribute, i.e. respondents included them in their concerns for improved environmental condition which reduced the focus of respondents on water restrictions.

6. Conclusion

Researchers interested in benefit transfer applications and developing metrics for environmental evaluation programs may be tempted to minimise variability by standardising valuation experiments across different locations. In this paper such an attempt is reported, where the same CM experiment has been performed in several European countries as well as in an Australian setting. The results provide some important insights and reminders for the design of CM experiments.

The key lesson from the study is that maintaining a standard approach to the application of a choice experiment across different case study situations is problematic. In this case study application, there was little opportunity to tailor the choice tradeoffs or design to the particular characteristics of the situation being addressed. Instead, the choice scenarios were framed in a very simple format with only two key attributes, ignoring the potential for other factors such as recreation use or water quality to be included. The focus on simplicity and the lack of tailored framing was not conducive to accurate results.

These results confirm the importance of the normal design phases at the case study level in CM applications, where substantial effort and rigour is applied to ensure that choice scenarios are framed accurately to respondents. When choice experiments are constrained to a standard approach across applications the risks increase that framing is not accurate. The results of this study identify that it is not appropriate to transfer the same valuation scenarios across international contexts. As well, the results suggest that a great deal of care has to be taken in developing metrics for environmental evaluation. While there are often efficiencies involved in running large scale environmental programs, benefits have to be valued in contexts that are framed accurately and appropriately before they can be applied as evaluation metrics.

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