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Exploring Scope and Scale Issues in Choice Modelling Design

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1. Introduction

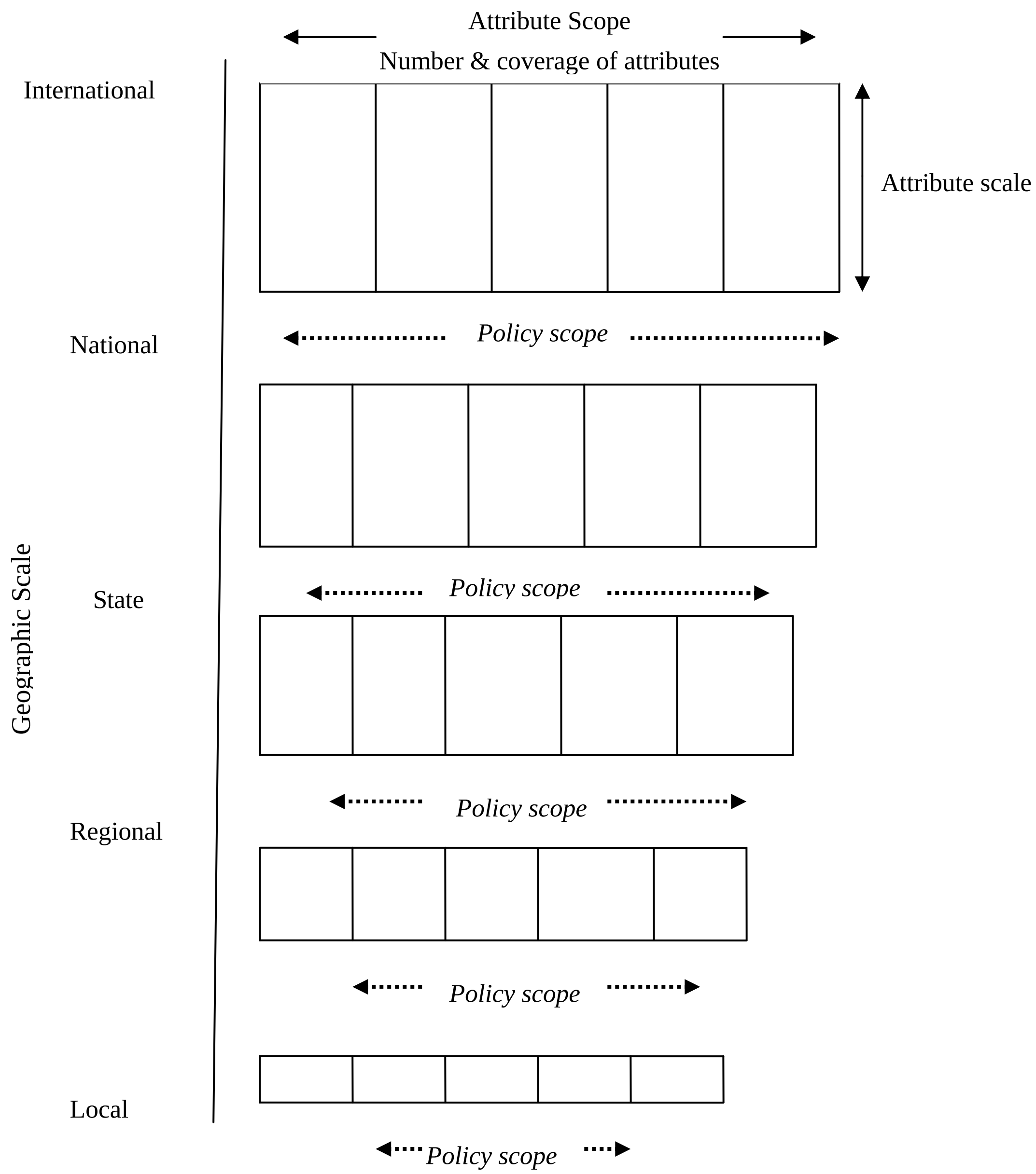
The choice modelling (CM) technique has been widely used in the past decade in environmental valuation, especially when non-use values are involved (Louviere et al. 2000, Bennett and Blamey 2001). The analyst designing a CM application typically has some discretion over the size and complexity of tradeoffs that will be offered in the choice alternatives (Carson et al. 1994). In most cases the analyst balances the desire to make choice sets realistic against the desire to minimise choice complexity. Important decisions thus need to be made about the scope of the tradeoff that will be presented to respondents, the actual quantities involved, and the way in which those tradeoffs are framed.

Key tasks in the design of an experiment are to define the scope, scale and frame of the tradeoffs that will be presented to respondents. Here, the following definitions are offered to clarify the concepts involved: The **scope** of a good involved in a stated preference experiment refers to the dimensions used to define the good and the tradeoffs involved, the **scale** refers to the quantities involved, and the **framing** to the context in which the choices are made. Using the protection of marine areas as an analogy, the scope of the tradeoffs relate to the key attributes used to define the good, such as coral reefs, fish and marine mammals, the scale to the quantities involved, and the framing to the institutional and policy context in which different levels of protection can be offered.

Scale and scope issues are often intertwined, because increasing amounts of an environmental good often involve both changes in the quantity (scale) and extent of the good (scope). To better identify this relationship for CM applications, the following definitions are offered, with a summary provided in Figure 1. Within the contingent market there are two aspects to scale changes to consider, with **geographic scale** is focused on the magnitude of the good under consideration, while **attribute scale** describes the levels of the attributes. Essentially the geographic scale identifies the broad quantity of the good that is under consideration, while attribute scale identifies the variation in quantity that is offered within the choice sets. As an experiment is framed at lower levels of geographic scale, the attribute scale involved in a choice experiment is typically smaller (as demonstrated in Figure 1).

In a CM experiment the scope of the tradeoff, or extent of the contingent market considered in a choice set, can be defined in two important ways. **Attribute scope** refers to the dimensions of the good being considered, which is normally defined by the selection of attributes to build choice alternatives. Attribute scope can be varied by changing the number and definitions of attributes used in choice sets. **Policy scope** refers to the type of tradeoff or policy option that is used to describe how choice alternatives can vary between each other. This can be varied by using policy labels or descriptors of different alternatives in labeled choice sets, or by describing how varying management and policy options can lead to specific attribute combinations. Both attribute scope and policy scope may correlate to changes in geographic scale, with potential variations in the contingent market typically much lower at limited geographic scales compared to extensive geographic scales. This is demonstrated in Figure 1 by the horizontal reductions in scope as geographic scale diminishes.

Figure 1. Scale and scope options in CM experiments



Some information about setting the frame and scope of a CM application can be gained by reviewing the development of the contingent valuation (CV) method, which is the other stated preference technique used to assess environmental tradeoffs. In the 1980s, a great deal of attention was paid by CV practitioners on appropriate responses to a scope test (Arrow et al. 1993). This was normally focused on changing the amounts of the tradeoff on offer in a split-sample experiment and testing that respondents were sensitive to such variations. The scope test in CV was poorly labelled because it was typically focused on changes in the quantity being offered rather than changes in the type of tradeoff being considered. It could be more accurately described as a ‘scale’ test.

In addition to deciding the scope and scale at which tradeoffs should be presented, the analyst designing a CM experiment also has to decide how tradeoffs should be framed. Framing refers to the context in which tradeoffs are made, and is related to the institutional and policy setting where the choice alternatives become possible and the payment mechanisms are realistic. There is often some interplay between the way in which a CM study is framed and the decisions about the appropriate scope and scale. For example, if a policy issue is framed as a national government responsibility then the scale and scope of tradeoffs in the contingent market need to relate to the institutional context.

These framing, scope and scale issues can be illustrated in relation to a CM study valuing protection measures for the Great Barrier Reef (GBR) in Queensland, Australia. Because the GBR is a very large and complex natural resource, there are many ways of defining different tradeoffs to be considered within a CM experiment. The focus can vary from a single area and aspect of the GBR through to consideration of the full asset, while the scope of tradeoffs to be considered can vary across different policy issues and potential management actions. The scale and scope that is chosen should reflect the institutional frame that is used in an experimental context.

A key issue for the CM analyst is that policy needs may require values for tradeoffs at different levels of scope and scale. However, it is unclear whether values from a study in one context of scope and scale can be simply extrapolated or transferred to another context. The focus of this report is to explore the issues of scope and scale in CM experiments in relation to the GBR, with the aim of identifying how values may be sensitive to the structure and context in which they have been offered.

The structure of this report is as follows. In the next section, a summary of the previous treatment of scale and scope issues is presented to clarify the concepts involved. This is followed by a review of the scope and scale issues relevant to CM in Sections Three and Four respectively. A review of the case study of interest, the Great Barrier Reef, is provided in Section Five, followed by discussion about the implications for the design of a CM experiment in the final section.

2. A Historical Overview of the Scope and Scale Issue

Issues of scale and scope changes have been widely explored in the non-market valuation literature, especially in the development of the CV method (Mitchell and Carson 1989). Kahneman and Knetsch (1992) first introduced the "embedding effect" in CV, suggesting that willingness-to-pay (WTP) measures were insensitive to the amounts of the good involved because the good to be valued was often 'embedded' within a more inclusive good. They suggested that the responses to a CV experiment were more akin to the purchase of moral satisfaction than bids for a particular amenity. Diamond and Hausman (1994) advanced a similar hypothesis about a warm glow effect, arguing that CV responses did not distinguish adequately between differently scoped goods. While some studies found that respondents were sensitive to different scopes presented to them (Mitchell and Carson 1986; Mitchell et al 1989; Carson and Mitchell 1991), other studies supported the claim of scope insensitivity (Desvousges et al 1993; Diamond et al 1993; Diamond and Hausman 1994; Schkade and Payne 1994).

The responses to the significant challenge to CV of the scope insensitivity and embedding effect arguments can be classified into three groups. In the first are the theoretical arguments, where different reasons for insensitivity to changes in scale and scope were developed. Hanemann (1994) categorised the embedding effect of Kahneman and Knetsch as three distinct notions. The first was the 'scope' effect, where WTP bids were insensitive to the amount of the good being offered. The second notion was the sequencing effect, where the value of an item changed according to whether it was offered first or alone, as against later in a long list of choices (Randall and Hoehn 1996). The third notion was the sub-additivity effect, where the WTP for a composite of goods is lower than the sum of the WTP of the goods valued separately (Hanemann 1994, Randall 1997). The identification of sequencing and sub-additivity effects provided theoretical explanations of why scope insensitivity might occur.

The second group of responses incorporate the more practical options for identifying and dealing with scope issues. A number of authors argued that scope insensitivity is largely due to problems associated with survey design, such as vague descriptions of the environmental resource or a lack of credibility about delivery of the policy (Carson and Mitchell 1995; Smith 1992; Hanemann 1994). The NOAA panel of experts reviewed the methodology and appropriateness of CV, and paid particular attention to embedding and scope issues (Arrow et al 1993). The panel recommended that a scope test should routinely be included in a CV application to provide some confidence that respondents could distinguish the appropriate extent of the issues being presented. Scope tests are generally conducted through a split-sample experiment, the first involving the amenity in question, and the second involving a more encompassing amenity. Higher value estimates are expected from the latter sample (Rolfe and Bennett 2001:208-9).

The third area of response to concerns about scope insensitivity involve the development of choice experiments such as CM, where variations in choice are incorporated within the choice sets offered to survey respondents (Rolfe et al. 2000). The design of CM means that different attributes (scope) and variations in quantity (scale) are specified and automatically offered and considered by respondents. This forces some internal consistency of valuation (Adamowicz et al. 1998, Rolfe and Bennett 1992). If the contribution made by an attribute to choices and values is found to be insignificant, evidence of perfect embedding is established. The use of CM internalised some elements of the scope test recommended for CV by the NOAA Panel, providing an advantage for the use of CM.

CM internalises some level of scale and scope dimensions for the good to be valued within the choice sets offered to respondents. However, such internal tests can be considered “weak”. The internal scope test is limited to the types of attributes used to describe the good of interest, while the internal scale test is limited to the variations in quantity offered within each attribute. A stronger test is to offer different sub-samples of choices where the goods under consideration are of varying inclusiveness. These types of tests have been carried out in some studies where there has been interest in identifying whether values can be transferred from one case study application to another where the ‘frame’ of the study differs (Rolfe and Bennett 2006). These issues are explored in the following sections.

3. Scale Differences in Choice Modelling

Much of the attention in stated preference experiments on scale and scope dimensions has focused the quantity of the good involved. There are two key issues of interest in designing a CM application. The first involves understanding how the initial framing of the quantity to be considered affects the way in which respondents make tradeoffs. For example choosing whether to focus at the local, regional or national scale for an issue involves very different quantities, potentially influencing the context in which tradeoffs are framed. This issue is most often classified as a geographic scale test, and is usually external to the quantities presented in a single choice experiment.

The other issue of focus is on the internal scale test, where the issue is how the marginal tradeoffs within a CM experiment vary as different quantities of attribute levels are presented. In many cases the potential for diminishing marginal utility is considered to be low, so only linear parameter estimates are generated for each attribute. The challenges here are to identify when respondents treat changing quantities of an attribute in more complex ways and the appropriate design and analysis responses.

There is potential for changes in scale, both at the macro geographic level and at the internal choice set level, to affect value estimates though the effect of diminishing marginal utility. This is particularly likely across geographic scale differences. As the frame in which a tradeoff is scoped varies from smaller to a larger scale, then the marginal effects of a one-unit change become smaller (Rolfe and Windle 2008). For this reason, tradeoffs framed at a larger scale (i.e. nationally) can be expected to have lower marginal values than tradeoffs framed at a smaller scale (i.e. locally) (van Beuren and Bennett 2004). These issues may be enhanced or offset to some extent by other factors such as familiarity, loyalty, proximity, perceptions of responsibility and perceptions of institutional arrangements. The variation of diminishing marginal utility across different scales of presentation, both across and within CM studies, is likely to vary with the issue being addressed.

Geographic scale tests

A number of CM studies have been performed to identify whether value estimates are consistent when the tradeoffs are framed at different levels of geographic quantity. The focus of these tests has been to identify if values can be transferred from one geographic quantity frame to another (Rolfe and Bennett 2006). The issues can be illustrated with three similar studies performed in Australia to explicitly address geographic scale issues (van Bueren and Bennett 2004, Rolfe et al. 2006, and Rolfe and Windle 2008).

Van Bueren and Bennett (2004) performed a number of benefit transfer tests to examine how values change across different population and frames of reference, focusing on tests for geographic scale differences. Separate surveys were undertaken to estimate community values for land and water protection in Australia at national and regional contexts. The same set of attributes was used in each survey, holding attribute scope constant, but the level of attributes differed by the geographical scale involved. Results showed that all of the implicit prices generated at a regional context exceeded those generated at a national context, indicating that framing the surveys at different levels of geographic scale generated differences.

Rolfe et al. (2006) report the conduct of valuation experiments relating to floodplain development and water allocation in Central Queensland. Three split-sample CM experiments were conducted, involving the Fitzroy basin as a whole as well as two separate sub-catchments. The surveys were identical apart from the case study information and the levels for the relevant attributes. The results indicated that the implicit prices were similar between the catchment and sub-catchment studies but that the models were not equivalent. Some framing effects were identified, as the combined values for the two sub-catchments used were often larger than values for the whole catchment.

Rolfe and Windle (2008) explored the values held for environmental protection (vegetation, soils and waterways) at both state and regional catchment levels. They found that value differences between state and regional contexts were not significant. The conclusions drawn were that no adjustments are needed for benefit transfer when the scope only varies between state and regional contexts.

Internal scale tests

The development of the multinomial logit model (MNL) (McFadden 1974) provided a statistical framework for modelling how the attributes of a particular amenity among a set of alternatives explain consumer choice responses. The standard MNL model that is typically applied to analyse CM data requires assumptions that attributes are independent and linear-in-parameters, implying that survey respondents treat different quantities of a single attribute in a uniform way. The results of many CM experiments appear to be consistent with this approach (Bennett and Blamey 2001). However, there are a number of CM studies where the results suggest a more complex relationship between the levels of the attributes on offer and choice behaviour (Louviere et al. 2000). There are several reasons why a simple parameterization of internal scale differences may not be sufficient.

Respondent heterogeneity drives many of the differences. For example, proximity (and loyalty) effects have been identified in distance-decay functions where people may have higher values for local areas compared to ones further away (Hanley et al 2003; Sutherland and Walsh 1985; Pate and Loomis 1997; Bateman et al 1999; Morrison and Bennett 2004; Concu 2007). Decision processes are another potential explanation of why responses to internal scale differences (changes in attribute levels) are not independent. In some cases respondents may prioritise between attributes in ways that treat some attributes as priors (Blamey et al. 2000) or preliminary decision points, effectively leading to nested decision structures.

Another area of potential variation from a standard treatment of respondent choices occurs when marginal effects are observed. The use of a linear additive model assumes the concept of constant marginal utility. While the use of constant marginal values may be locally correct, it may overstate the total benefits of an increase in the resource for large changes. It is entirely feasible that people have diminishing marginal utility or disutility for an attribute as the scope of the good under valuation expands. The issue of diminishing marginal values has been explored in a number of CM studies. It has been found that the whole bundles of improvements are valued less than the sum of the component values (Bateman et al 2002), confirming the sub-additivity effect identified by Hanemann (1994) and Randall (1997).

Rolfe and Windle (2003) demonstrate significant non-linearities for protection of aboriginal cultural heritage sites, with little or no increase in part-worths past the first level of a 10% increase in protection for two general community samples. In contrast, an indigenous community sample had increasing partworth values for the higher levels of protection as set by the attribute levels. These results confirm that diminishing marginal values can be expected to vary across population groups. Windle et al. (2005) identified diminishing marginal values for estuary health in Queensland, while Whitten and Bennett (2006) also report evidence of diminishing marginal values for the protection of two wetlands in southern areas of Australia.

Layton (2001) has demonstrated refinements in empirical estimation of discrete choice models to allow for diminishing marginal value per unit of attribute when both large and small improvements are valued. Loomis (2006) noted that most studies have not been focused on the detection of differences between marginal benefit estimates at different levels of overall supply. This implies that when supplies are at differing levels, the estimates from source studies cannot be transferred to other policy sites. He used meta-analysis regression approach to combine the findings of four studies and allow the marginal value per salmon to vary with the absolute increase in the number of salmon under various management alternatives.

Other evidence that marginal benefits vary with the scale within an attribute is provided by Morrison and Bennett (2004), who explored the effect of framing and scale of the good under valuation on value estimates in their benefit transfer study. They selected five “representative rivers” within different geographical regions of the New South Wales and conducted CM applications on each of those rivers using samples of people living within the river catchments and outside. Scope was held constant by using the same attributes across the surveys but the attribute levels were catchment specific. Differences in value estimates for the benefits of environmental flows were found across different river types and population categories. The results suggest that local and distant populations frame tradeoffs differently and that marginal benefits vary according to the scale of tradeoffs.

There is other evidence that the ranges over which attributes vary have has an impact on value estimates. Dellaert et al (1999) examined the effect of variations in attribute level differences on consumer choice consistency, and found that the choice consistency decreases as price level differences increase and absolute price levels increase. Recently, Hess et al (2007) allowed for asymmetrical responses to increases and decreases in attributes in relation to each individual’s specific reference points. Their findings suggested that preference formation may not relate to the absolute values of the attributes but rather to differences from respondent specific reference points.

4. Scope Differences in Choice Modelling

In a CM experiment, the scope of the tradeoffs that are presented to respondents are largely set by the attributes used in the choice sets, together with the way that the potential gains or losses are framed in an institutional and policy setting. In this context, the scope of a choice task can be expanded by adding or defining attributes more widely. Attribute scope may also be changed by describing attributes differently, or by changing the relationship between attributes or alternatives within a choice set. Scope may also be changed by defining the policy alternatives in different ways. Here, the impacts of these potential changes are reviewed in more detail.

Attribute Scope: Inclusion and Exclusion of Attributes

A key challenge in CM experiments is to summarise policy situations into a representative set of attributes. A researcher typically has some discretion over the number of choice alternatives and choice sets in a CM experiment (Louviere et al., 2000; Hensher, 2006b). Options to make choice sets more realistic by including more alternatives, attributes, levels and labels have to be balanced against the desire to minimise choice complexity by reducing the number of alternatives, attributes, levels and labels.

In order to reduce task complexity and cognitive burden imposed on respondents, issues are often “compressed” into a discrete number of attributes (Breffle and Rowe 2002; Caussade et al. 2005; Rolfe and Bennett 2008). However, there are also cases where attributes are “unpacked”, helping to provide more emphasis or information in a key area. Focusing on particular issues in this way appears to come with some risk. “Unpacking” positive attributes of a good into multiple sub-attributes can make a good or service seem more desirable, while “unpacking” attribute levels that are less desirable can make a good or service less desirable (Weber et al 1988; Starmer and Sugden 1993).

There may be mechanical issues associated with the selection of attributes, where the number of attributes presented can impact on the complexity of the choice task (Caussade et al. 2005; Hensher 2006a, Rolfe and Bennett 2008). Louviere (2001) argued that there is no empirical evidence to suggest that increasing numbers of attributes, number of choice options or numbers of choice sets (scenarios) impact mean preference parameters, but there is evidence that increases in these factors impact random component variability. In contrast, DeShazo and Fermo (2002), Hensher (2006a), Causssade et al. (2005) and Rolfe and Bennett (2008) found that changes in the design of a choice set may systematically affect both the parameter estimates as well as the variances of the error terms, other factors being held constant.

Caussade et al. (2005:631) indicate that the order of impact of design dimensions of model variance was *first, number of attributes; second, number of alternatives; third, range of attribute levels; fourth, number of attribute levels, and last number of choice scenarios* (sets). They found that designs with four alternatives had the highest scale parameters, followed by those with five and then three alternatives. It is likely that increasing the number of choice set dimensions has benefits in terms of increased information and choice, but beyond some point there are offsetting costs in terms of increased complexity (Rolfe and Bennett 2008).

Attribute Scope: Definition and Presentation of Attributes

The complexity of choice set tasks can also be influenced by how attributes are defined. In this case the design dimensions of a choice experiment can be held constant while the complexity is varied by describing and scoping attributes in different ways. Little empirical work has been performed to explore the effect of changing attribute scope in this way. Rolfe et al. (2002) and Rolfe and Bennett (2002) reported the analysis of two labelled CM experiments focused on rainforest conservation where the only difference between experiments were the labels used for the choice alternatives. The labels were the locations of potential conservation activities, and hence scoped the conservation issues in different ways. By analysing the results with nested logit models, Rolfe and Bennett (2002) showed that respondents prioritised the choice alternatives differently. In this experiment, the changes in attribute scope directly influenced the choice patterns of respondents.

The use of iconic attributes raises other issues of attribute scope. In the use of iconic attributes, a “representative attribute” can be used to signal to respondents that particular categories of environmental assets are important. For example, Bennett et al. (2007) used Murray Cod as a threatened fish species to represent all threatened native fish in a valuation study of River Red Gum forests in Victoria. While the intention of the researchers was to present a more encompassing attribute to include all threatened native fish in the valuation exercise, there is potential for respondents to scope the attribute in different ways.

The presence of causally prior attributes within a CM experiment may also influence attribute scope. The use of causally prior attributes occurs when respondents adopt decision heuristics to make choices, and identify an attribute that needs to be satisfied first before other improvements can be generated (Blamey et al 2000). For example, improved water quality may be viewed by respondents as an ‘upstream’ condition that has to be satisfied before increases in fish species or recreation opportunities can occur. Defining an attribute in a way that encourages causally prior decision heuristics has implications for the way that both ‘upstream’ and ‘downstream’ attributes are scoped.

The order or position of attributes and sequence of micro-choice occasions represented by each choice set may affect value estimates. Kumar and Gaeth (1991) found larger attribute order effects when consumer's familiarity with product classes is low. The ordering effects also arise when the process of working through a series of choice tasks influences stated preferences, suggesting that learning effects may change the way that survey participants scope the attributes. While Carlsson and Martinsson (2001) found instability of preferences when the choices were presented as the first eight encountered as opposed to when the same set of questions were the last eight seen questions, Phillips et al (2002) found respondents' stated preferences remain unchanged throughout the choice task sequence.

Policy Scope: Mapping the extent of the contingent market

In some situations the scope of the tradeoffs to be considered are not just defined by the attributes of the good involved, but also by wider institutional and policy contexts. In many CM experiments the wider policy context is uniform across choice sets, and hence can be considered part of the way that choices are framed to respondents. For these CM experiments, scope effects do not extend to policy issues. Where a policy or institutional mechanism becomes part of the choice sets that vary between profiles, then these become part of the way in which the contingent market is scoped to respondents. There are two key ways in which policy scope can become an important part of CM experiments.

The traditional way of including policy scope has been through the use of labelled choice sets. In some cases labels for choice alternatives are used in CM experiments to convey information about institutional, governance or other aspects of a choice option. Labels are often used to categorise key choice alternatives, helping to streamline the choice process. Rolfe and Bennett (2002) report the conduct of labelled choice experiments on rainforest conservation, where the labels identified the location of the rainforests to be protected. Brisbane residents had higher values for protection options in Queensland compared to sites in New South Wales, followed by sites overseas. The use of nested models identified a structure of choice patterns that were more consistent with perceptions of responsibility driving choices rather than proximity or other factors.

An alternative way of including policy scope is to include information about the process used to achieve outcomes as part of the attribute set. There are some examples emerging of this approach, where the options presented to respondents includes not only information about the environmental outcomes but also of the policy options to achieve them. Johnston and Duke (2007) report one case study where the willingness to pay for agricultural land preservation varied with the policy mechanism employed. The choice experiment involved six attributes, one of which identified the policy technique and implementing agency. Roberts et al. (2008) compared two CM split samples where in one sample, probabilities were attached to the environmental outcomes described in the attribute levels (eg. 10% chance of algae bloom).

5. The Great Barrier Reef

The design of a CM experiment focused on valuing improvements in protection of the GBR will generate a number of scale and scope issues. This is because the size and complexity of the natural asset and the issues involved means that a CM experiment could be framed in a number of different ways. In this section, some background to the GBR is provided as a precursor to discussion about potential scale and scope issues.

The GBR is the largest coral reef ecosystem in the world and one of the world's most important natural assets. It stretches more than 2,300 km along the northeast coast of Australia from the northern tip of Queensland to just north of Bundaberg, covering an area of 35 million hectares (Hand 2003). The resource management issues at GBR can be examined across various geographical scopes because of the wide geographical coverage and the large number of reefs and bioregions involved. The GBR includes approximately 2900 individual reefs, ranging in size from less than one hectare to more than 100,000 hectares. The Marine Park has been classified into 70 bioregions, each of which is distinctive in terms of its physical and biological biodiversity. Each bioregion contains plant and animal communities, together with physical features, that are significantly different from the surrounding areas and the rest of the GBR area (GBRMPA 2006). Hence the policy context in terms of natural resource management in the GBR could be the whole reef area, a single reef area or a bioregion.

The environmental tradeoffs being considered can also be multifaceted across the GBR due to several factors. First, different resources may be found in different areas. The coral reefs and other non-reef bioregions are important to many marine species and maintain a rich biodiversity (GBRMPA 2006). There are an estimated 1500 species of fish and more than 300 species of hard, reef-building corals. The GBR also provides feeding and nesting grounds for the internationally listed endangered species such as dugong and Green and loggerhead turtles. In addition, the islands and cays in the GBR support several hundred bird species (Hand 2003). Second, there are also a number of uses attached to the Marine Park. The entire Great Barrier Reef Marine Park is zoned, with different uses permitted in different zones (GBR 2006). These uses include commercial use such as shipping, tourism and fishing, non-commercial use such as scuba diving, boating, snorkelling and recreational fishing, and other uses of ecosystem services such as research, maintenance of biodiversity and the maintenance of migratory species and habitat protection (Hand 2003).

The variations in environmental features and natural resource use across various geographical scopes within the GBR can be defined by the selection of attributes and labels in CM studies. Hence the environmental tradeoffs can be modelled through the use of those attributes that are relevant to the specific geographical context. As the environmental features and natural resource use may be quite different across various reef areas or bioregions within the GBR, management priorities across various geographical scopes may also differ. For instance, the Green Zone plays a vital role in marine species recovery, so extractive activities such as fishing and collecting are banned within this region (GBRMPA 2006).

A number of initiatives have been undertaken by the Australian and Queensland Governments in recent years. For instance, the entire GBR Marine Park has been rezoned to better protect the Reef's biodiversity, and to maintain the biological connections and ecological processes that sustain the GBR ecosystem. The new Zoning Plan increased the total percentage of highly protected areas to 33.3 per cent of the GBR Marine Park. Other new initiatives include addressing declining water quality, improving the ecological sustainability of fisheries through improved fisheries management arrangements, and managing tourism, boating and other recreational activities (GBRMPA 2006). Improved information about the values that the community holds for such protection measures will help to evaluate potential investments and guide the efficient allocation of resources.

6. Implications for estimating values for improved protection of the GBR

The size and diversity of the GBR means that any study on valuing improved protection measures can be applied at different levels of scale and scope. For example, studies might be conducted at several different geographic scales, ranging from the whole GBR down to a single reef area. As well, the natural assets and issues might be scoped in different ways, and community responses to varying tradeoffs and different levels of improvement may be complex.

The range of potential options for presenting a CM experiment raises a number of theoretical and operational issues to consider. The first key issue is to identify the most appropriate combinations of scale and scope to incorporate into a CM experiment. The general approach to designing an experiment is to identify the key policy requirements and tailor the scale and scope of tradeoffs to the relevant policy issues. However, in the GBR case study there are a number of different policy issues to cater for, ranging from local case study issues to those relevant to the whole GBR.

In this case the policy requirement is to generate value estimates that can be applied to a range of scale and scope combinations. This has been characterised by Rolfe and Windle (2008) as requiring a systematic database of relevant values which can then be used as required to input values in different policy evaluations. An appropriate study then might assess values for increased protection measures that can systematically be adjusted to different scale and scope situations.

The second key issue to address is to identify whether values can be directly transferred between different geographic scale frames or whether they require adjustment. The evidence for this requirement is mixed, so any work to develop a systematic database of non-market values for protecting the GBR should identify the extent to which diminishing marginal utility and other factors drives differences across geographic scale, such as between local, regional or whole-GBR frameworks. This might involve the conduct of split-sample surveys or other experiments to test whether differences in the way that tradeoffs are framed significantly influences results. Other systematic scale differences, such as those relating to institutional structures and policy instruments, should also be considered in this process.

A third key issue to address is to identify the appropriate tradeoffs to present to survey respondents and to define and scope them into attributes. The relevant tradeoffs are likely to vary by the geographic and policy scale being used, so attribute definition may need to vary between case study applications. For example, the relevant attributes in a case study for a local area may be different to the attributes used in a study of the whole GBR. Attribute scope may also be sensitive to the knowledge, use, location and characteristics of survey participants, so these complexities may need to be identified and controlled in an experiment. As well, care needs to be taken that any identification or grouping of issues into a small number of discrete attributes does not generate problems of mis-specification or bias.

With the GBR, the scoping of tradeoffs might involve more than identification of the key environmental assets. There are a variety of different environmental pressures on the GBR, which can be broadly categorised into water quality problems from land-based activities, environmental issues arising from ocean-based activities, and potential impacts from climate change. These pressures come with differing levels of scientific understanding and certainty about the outcomes of policy intervention. Scoping tradeoffs into attributes may involve some consideration of these types of pressures, or the management activities to address them, in order to adequately capture the policy choices.

A fourth key issue to address is to identify how respondents may react to scale differences within a choice set, understanding whether diminishing marginal utility or threshold effects require the tradeoffs to be treated in different ways. For example, as the Green Zones play a vital role in marine species recovery and retaining the unique and iconic status of the Reef for future generations, having some minimum amount or proportion of Green Zones may be an important threshold that respondents consider when making choices.

The design of a CM experiment is a challenging process requiring requiring a combination of logic, experience and empirical detective work as described by Carson et al. (1994), Louviere et al. (2000) and Bennett and Blamey (2001). The research summarized in this report helps to conceptualise some of the tradeoffs that analysts make when setting the scale and scope of the choice tasks. These are important tasks for large and multifaceted issues such as those relevant to protection of the GBR. Developing more systematic approaches to these challenges will help to identify how a particular experiment should be framed and a better understanding of subsequent results.

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