Chapter 10
Benefit Transfer: Insights from Choice Experiments

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Abstract In this chapter we explore six key reasons for the close alignment of choice modeling (CM) experiments with benefit transfer applications. Of these six, some relate to the richness of value estimate output that is generated in CM applications, whereas others involve the insights into choice behavior and the nature of preferences that are gained through the use of the technique. These outcomes improve the accuracy of the benefit transfer process and also provide more verification and confidence in the results. An additional focus of the chapter is to explore the tension between improving the accuracy and insights from CM on the one hand against, on the other, the need to make benefit transfer practical and operational. Although there is an extensive literature on the development and operation of the CM technique, it is not practical to cover this in a single chapter; instead the focus here is on the aspects of CMs that offer the most insight into benefit transfer processes.

Keywords Benefit transfer · Choice modeling · Methodology

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10.1 Introduction

Choice modeling (CM), also known as choice experiments (CE) or discrete choice experiments (DCE), was developed as a valuation technique in the early-to mid-1990s (Carson et al. 1994), after the establishment of choice-based experimental methods for application in marketing and transport (Louviere and Hensher 1982; Louviere and Woodworth 1983). Within a few years, the technique was developed for application to environmental contexts (Adamowicz et al. 1998; Blamey et al. 1999; Rolfe et al. 2000). While the formulation of CM for the analysis of environmental tradeoffs was driven in part by the controversy over the contingent valuation method following the Exxon Valdez case (see Arrow et al. 1993), it was accompanied by an interest in the use of CM for potential application as a source of value estimates for benefit transfer. Some of the foundation studies in environmental CM were conducted, at least in part, with the expressed aim of generating benefit transfer functions (Jiang et al. 2005; Johnston 2007; Morrison and Bennett 2000; Morrison et al. 2002; van Bueren and Bennett 2004). Many reviews of benefit transfer (e.g. Brouwer 2000; Johnston and Rosenberger 2010; Morrison and Bergland 2006; Navrud and Ready 2007; Rolfe and Bennett 2006) have drawn on insights from the use of CM studies as generators of source estimates of value.

The reasons for the expansion in use of the CM valuation technique being so closely associated with benefit transfer can be grouped into six areas. Of these six, some relate to the richness of value estimate output that is generated in CM applications, whereas others involve the insights into choice behavior and the nature of preferences that are gained through the use of the technique.

The first reason relates to the hedonic characteristics of a CM, where describing the issue of interest in terms of component attributes, labels and levels generates a more disaggregated output compared to other non-market valuation techniques. The second is that CM is capable of generating estimates of compensating surplus that are related to both site and respondent characteristics in the case study of interest. These estimates can then be used to arrive at values for any combination of attributes, labels and levels through a benefit transfer function. A related third reason is that the richness of predictive outputs allows greater opportunities for testing the equivalence and convergent validity of value estimates for use in benefit transfer.

The fourth reason relates to the insights that the analysis of CM data offers into the decision processes that respondents employ. A variety of models and analytical techniques is available to allow analysts to identify and test a number of potential biases and effects that relate to both choice behavior and methodological factors. The fifth reason relates to the framing of choice experiments. Tests have been conducted to identify how the context of choice decisions can affect value estimates through factors such as payment vehicles, geographic proximity of respondents to the study site, feelings of responsibility, types of management actions, and outcome likelihoods. The sixth reason relates to the ability of CM to provide insights into preference structures. Together with framing advantages and the potential use of benefit transfer functions, these insights can make subsequent assemblages of values more consistent with utility functions and address concerns about limited theoretical foundations.

These methodological advantages come at a cost for benefit transfer applications. Researchers have focused on explaining choice tradeoffs at finer and finer levels, with more attention being given both to the number of different factors that may influence respondents' choices and ways of modeling those choices. These attempts have largely been successful, as they have demonstrated with increasing levels of precision that values are sensitive to a large number of factors and influences. Paradoxically, these efforts to increase the precision of value estimates make benefit transfer more complex and problematic. Each split sample choice experiment that successfully demonstrates value sensitivity to site, population, framing or methodological factors generates another predictive or adjustment factor that can be incorporated into benefit transfer functions.

The six key reasons why CM applications are closely aligned with benefit transfer are explored in the following sections of this chapter. An additional focus is to explore the tension between improving the accuracy and insights from CM on the one hand against, on the other hand, the need to validate and make operational benefit transfer. This tension is discussed in the final section. An important point to note is that there is an extensive literature on the development of the CM technique, methodological issues and valuation case studies that is not practical to cover in a single chapter; instead the focus here is on the aspects of CMs that offer most insight into benefit transfer processes.

10.2 Describing the Tradeoffs

10.2.1 Representing Issues with Attributes

A defining aspect of CM is the decomposition of a case study issue into component attributes, labels and levels. At an operational level, this "unpacking" of the elements that comprise values as specified by Kelvin Lancaster's demand analysis (Lancaster 1966) helps respondents to comprehend and construct the choice tasks, identify and remember the key factors that might be significant, and shows different scenarios in more comprehensive and realistic ways (Adamowicz et al. 1998; Bennett and Blamey 2001; Rolfe et al. 2002). At an analytical level, the disaggregation of values into sub-components allows for a richer set of predictor variables to be generated and allows decision structures to be better modeled. Furthermore, the set of value component estimates creates opportunities for a wider spectrum of point value transfers from a single CM data collection exercise (Holmes and Adamowicz 2003; Louviere et al. 2000; Rolfe and Bennett 2006).

A particular advantage of CM is that it allows the description of resource management contexts to be presented in much broader terms in comparison to other non-market valuation techniques. This can be illustrated in environmental applications, where as well as describing effects on the environmental assets involved, tradeoffs can also reflect the impacts of changing resource management on social and economic conditions (Morrison and Bennett 2004; Rolfe et al. 2000; van Bueren and Bennett 2004). Environmental impacts can also be described using attributes that focus on ecological processes (e.g. Johnston et al. 2012; Liekens et al. 2013). Other ways of extending the context of resource tradeoffs have been to include risk outcomes (e.g. Glenk and Colombo 2011; Wielgus et al. 2009) and management options (e.g. Czajkowski and Hanley 2009; Hanley et al. 2010; Johnston and Duke 2007).

The analyst designing a CM application typically has discretion over the selection and description of attributes, the number of choice alternatives and choice sets that are presented to survey respondents, and the way that choices are framed, including those against opportunity costs (Hensher 2006; Louviere et al. 2000). Researchers have paid some attention to issues of choice set dimensions and application, concerned that presentational differences could affect subsequent value estimates. There is some evidence that the structure of choice sets in terms of the number of attributes and choice alternatives can impact on value estimates (Caussade et al. 2005; Hensher 2006, 2008; Rolfe and Bennett 2009). In most cases the analyst balances the desire to make choice sets realistic (including more choice alternatives, attributes, levels and labels) against the desire to contain choice complexity (reducing the number of alternatives, attributes, levels and labels) within respondents' cognitive capacities. The decision about what attributes to include in an environmental valuation exercise and how to describe them is likely to continue to be a multifarious task, with tradeoffs being made between respondent comprehension, ecological validity, policy relevance and content validity (Johnston et al. 2012).

The use of values from CM applications for benefit transfer can be limited by variations in the selection of attributes and attribute ambiguity (Johnston et al. 2012). There is no standard approach to the selection of attributes to be included in any particular valuation, even for relatively common environmental contexts such as forests, rivers, or wetlands. For example, two Scandinavia valuations for marine water quality (Eggert and Olsson 2009; Kosenius 2010) applied two quite different sets of attributes. A related problem occurs when indicator or iconic species are used to represent a species group or ecosystem. Care must be taken with the interpretation of values for those species, as people are known to have higher willingness to pay (WTP) for some types of species, such as mammals, over others (Loomis and White 1996; Tisdell et al. 2006); for more charismatic species (White et al. 1997); and for rarer species (Christie et al. 2006). Jacobsen et al. (2008) have shown that simply naming and hence "iconizing" only a few species can attract higher value estimates than using a quantitative description.

Issues can also emerge in the way that attributes are described. Attribute levels are often described in CM applications in subjective terms; for example, quantitative changes may be described as "small/medium/large" while qualitative changes may be described as "high/medium/low" or "good/medium/poor" (Eggert and

Olsson 2009; Kosenius 2010). Such subjective descriptions make it very difficult to estimate specific outcome benefits, and this reduces the potential for application in benefit transfer. Despite these complexities and potential limitations, the ability to present issues as a set of attributes within a CM and to generate individual part-worths by attribute is a key reason why the development of CM techniques has been closely associated with benefit transfer.

10.2.2 The Cost Attribute

The framing of the cost attribute and associated payment vehicle has received considerable attention in the wider stated preference literature because of the potential for starting point bias, anchoring effects, and different forms of protest bids that bias value estimates. Choice modeling experiments have allowed these issues to be tested more thoroughly. Both Hanley et al. (2005) and Kragt (2012) found that higher cost levels did not lead to significantly higher value estimates. In contrast, Carlsson and Martinsson (2008) found that higher cost levels resulted in higher WTP estimates, but that the design of the first choice set (starting point bias) did not have a significant impact on WTP estimates. The latter contrasted with the results of Ladenburg and Olsen (2008) who found that varying price levels in the first choice set did influence the WTP estimates, but only for females and not males. They also found that impact of the starting point bias diminished as the number of choice sets increased, in line with the "discovered preferences hypothesis" (Braga and Starmer 2005) or learning effects (Bateman et al. 2008). The concept of a choke price (Kragt 2012; Mørkbak et al. 2010) has been a useful contribution to the design of CM and the need to include high enough cost levels to invoke an income effect.

10.2.3 Labeling the Alternatives

The use of labeled alternatives in choice sets allows more nuanced descriptions of tradeoffs as well as better opportunities to test for the influences of potentially relevant factors. Alternative labels can also help to communicate key issues of importance, and to distinguish policy dimensions in the available options. There are two main approaches to the use of labels. The first is to use a label to capture other factors that may be important to choices, holding attributes and levels constant across choice alternatives. For example, Carlsson et al. (2011), Morse-Jones et al. (2012) and Rolfe et al. (2000) used geographical or country labels to help communicate to respondents that other factors such as institutional settings, cost, control and responsibility may differentiate alternatives.

In the second approach, labels can be used to signal that the policy options vary between choice alternatives, with the levels for each attribute tailored to the relevant label, helping to represent case study scenarios more accurately. For example, both

Czajkowski and Hanley (2009) and Rolfe and Windle (2013) found that using management policy labels provided respondents with relevant information about the way in which the environmental good is provided, leading to a significant increase in the scope sensitivity of welfare measures.

On the other hand, labeled alternatives may increase the cognitive burden faced by respondents, leading them to use a form of choice heuristic by which choices are based primarily on the labels, with less attention being paid to variations in the levels of the attributes. Blamey et al. (2000) reported that the inclusion of policy labels appeared to shift respondents' attention from the attributes to the labels, but they found no significant differences in the welfare estimates.

10.3 Extrapolating to Benefit Transfer Functions

Since the focus on benefit transfer in the 1992 special issue of *Water Resources Research*, there has been a preference in the literature away from the transfer of point values toward transfer of benefit functions (Johnston and Rosenberger 2010; Morrison and Bergland 2006). The arguments in favor of using benefit functions are that more detailed information is involved and that adjustments for different site and population characteristics between source and target case studies can be more easily applied (Rolfe and Bennett 2006). There is also the argument that benefit transfer functions are likely to be more consistent estimators of value than an amalgam of point source estimates. This point is explored further in Sect. 10.6.

Benefit functions can be derived in different ways, including those from single studies and meta-analyses (Johnston and Rosenberger 2010). A key strength of the CM valuation technique is that both the site and respondent characteristics in the source case study can be used to estimate compensating surpluses for any combinations of attributes, labels and levels. The same function can then be used for benefit transfer to target case studies with differing levels for site and population characteristics, so long as those levels lie within the respective ranges used in the source study. Some CM studies have been explicitly focused on framing the applications in ways that allowed subsequent value estimates to be used for wider benefit transfer applications, or to identify adjustment factors that facilitated values to be transferred across variations in contexts and frames (Morrison and Bennett 2004; Rolfe and Windle 2008; van Bueren and Bennett 2004). This approach essentially internalizes the potential for transferring benefit functions into the design of the application.

Although there is strong support in the literature to move away from point source transfers to benefit function transfers, the evidence from case study examples remains mixed (Johnston and Rosenberger 2010). Some researchers (e.g. Kerr and Sharp 2006; Morrison and Bennett 2004; van Bueren and Bennett 2004) have reported that many benefit transfer functions derived from CM applications do not satisfy convergent validity tests. Others (e.g. Rolfe and Windle 2008, 2012a) report benefit transfer functions which are robust to site and population differences. One conclusion drawn from these findings is that adjustment factors can be developed that account for differences in components such as scope (e.g. van Bueren and Bennett 2004), population types (e.g. Morrison and Bennett 2004), or distance effects (e.g. Concu 2007, Rolfe and Windle 2012b). Another conclusion is that although the results of CM applications are suited for benefit function transfer, there is some support for results to be harvested for point source estimates (such as when only part-worth values are transferred) rather than for benefit functions only.

10.4 Testing Equivalence and Convergent Validity of Value Estimates

Much of the literature relating to benefit transfer has focused on identifying the accuracy and validity of transferred values (Johnston and Rosenberger 2010). Two key foci of these approaches are the identification of measurement errors within a source study and the transfer errors associated with the application of source study values to a target site (Johnston and Rosenberger 2010; Rosenberger and Stanley 2006). Tests for measurement errors are typically assessed with split-sample experiments, whereas transfer errors are assessed by comparing source study value estimates against estimates derived from a primary study of values for the target site. In both cases these are typically performed as convergent validity or reliability tests, with welfare estimates assumed to be equal unless testing reveals otherwise (Johnston and Rosenberger 2010). However, some value differences between source and target sites can be expected because of site and population differences, complicating convergent validity tests (Chap. 18; Rosenberger and Stanley 2006). Alternative approaches are to set the null hypothesis that environmental values differ, and then use equivalence testing (e.g. Johnston and Duke 2008; Kristofersson and Navrud 2005) or to compare transfer errors against a benchmark (e.g. Brouwer 2000).

Choice modeling applications have provided insights into both measurement and transfer errors. In relation to the measurement errors, the ability to test for and incorporate site and population differences, deal with heterogeneity, specify functional relationships more accurately, and predict values by particular sub-groups has both improved the accuracy of CM estimates and helped to identify where remaining prediction variances and errors exist. In relation to transfer errors, the richness of predictive values provided by CM models for part-worths, compensating surplus estimates, benefit functions and error terms means that multiple comparisons are possible. Reasons for the satisfaction or failure of convergent validity tests can thus be forensically identified. Rolfe and Windle (2012a, b) demonstrate that transfer errors vary by attributes and labels, as well as between use and nonuse values and by the iconic nature of assets.

Many tests for convergent validity remain difficult to satisfy, with substantial transfer errors in some applications (Brouwer 2000; Johnston and Rosenberger

2010; Rolfe and Bennett 2006; Rosenberger and Stanley 2006). In some, but not all, cases, failures appear to be linked with larger differences between sites and populations, or because of unincorporated factors such as scope differences (Rolfe and Bennett 2006). However, failures may also be driven by increasing accuracy and requiring tighter specifications of primary studies, making it more difficult to transfer values to other sites that do not have identical characteristics. In these cases the use of equivalence testing (Johnston and Duke 2008) or a move towards preference calibration (e.g. Smith et al. 2002) may be required.

10.5 Respondent Behavior

In CM, the analyst is faced with the challenge of explaining the link between respondents' choices and their preferences for different attributes and their levels, in order to elicit meaningful welfare estimates. The use of benefit transfer has been enhanced by the insights that CM studies have allowed into respondent behavior, helping to identify key factors that influence choice decisions as well as to understand how choices may be influenced by methodological design. This has occurred in two main ways:

1. through refinements in statistical methods; and
2. through analysis of choice patterns.

10.5.1 Refinements in Statistical Methods

Refinements in statistical methods have occurred through a move away from use of the standard multinomial logit (MNL) model of CM respondent choices. More advanced models have allowed improved analysis of choice behavior by better representation of respondent heterogeneity in responses, more precise identification of random error components, and accommodation of variations in the ways that alternatives are considered (Adamowicz et al. 2008; Louviere et al. 2000). Researchers have dealt with preference heterogeneity by including attitudinal and behavioral variables (e.g. Brouwer and Spaninks 1999) or using random parameter or error component logit models to capture functional forms (e.g. Colombo et al. 2005), with improvements in the accuracy of benefit transfer to different population groups.

One area of focus has been to capture choice variation across respondents through the estimation of latent class models. These models, through their identification of sub-groups of respondents that share similar preferences, allow benefit transfer to be directed according to those sub-groups (Boxall and Adamowicz 2002). The accuracy of benefit transfer functions have been further developed through the estimation of utility in willingness to pay space to minimize confounding effects of heterogeneity in preference construction (Scarpa et al. 2008, 2009). The combination of CM predictive models with geographic information system (GIS) data has identified where values might need to be adjusted by location or other geographic factors (Tait et al. 2012), while van Bueren and Bennett (2004) identify that adjustments to benefit transfer functions may be required where scope differences exist, such as those between regional and national contexts.

10.5.2 Analysis of Choice Patterns

One strength of the CM technique is that it allows more detailed analysis of choice behavior through more comprehensive and accurate models. The testing of methodological issues is also facilitated. An example of the former is the use of nested logit models to identify path-dependent choices (Louviere et al. 2000). Other tests have identified respondents who had made choices representing lexicographic preferences (Rulleau and Dachary-Bernard 2012), or who have used different patterns of decision heuristics (Leong and Hensher 2012). Tests for incentive compatibility (e.g. Lusk and Schroeder 2004) have identified how elements of choice behavior have varied between hypothetical and real purchase settings.

Another area of focus in understanding choice behavior has been “attribute non-attendance” (Alemu et al. 2013; Campbell et al. 2011, 2012; Carlsson et al. 2010; Scarpa et al. 2009, 2010). While some studies have established that respondents do ignore some attributes, including the cost attribute (Campbell et al. 2012), the results of other studies produce ambiguous results. One of the sources of ambiguity is that the exact nature of non-attendance and the reasons for the behavior are not clear. Some evidence suggests that respondents place less weight on some attributes rather than ignoring them (Carlsson et al. 2010). Alemu et al. (2013) distinguished non-attendance responses into three separate categories (discontinuous preferences, zero preferences, and possible low preferences), allowing separate adjustments to be made. Herein lies the difficulty: Attribute non-attendance due to low or zero respondent preferences would appear to pose no challenge to value estimates. However, attribute non-attendance caused by respondents ignoring attributes because of the particular formulation of the choice task is problematic. Distinguishing between these two types of behaviour poses a particular challenge to CM practitioners.

Data from CM applications have also been used to explore methodological issues around the structure and complexity of choice experiments. A number of studies have identified sequencing or ordering effects where systematic changes in expressed preferences are observed along the sequence of valuation tasks, potentially related to learning and fatigue effects (e.g. Day et al. 2012; Day and Prades 2010; McNair et al. 2011; Rulleau and Dachary-Bernard 2012; Scheufele and Bennett 2012). One argument is that these effects indicate a lack of respondent familiarity and experience with changes in environmental quality and that resultant choices are not stable or coherent (Brouwer et al. 2010). Other researchers argue that choices may be strongly anchored to some initial starting point (Ariely et al. 2003), and that more experience (gained through undertaking repeated choice tasks) helps to reduce inconsistencies and stabilize preferences (List 2003).

Increasing complexity has been shown to increase choice inconsistency (DeShazo and Fermo 2002), the use of simplifying heuristics (Dhar 1997; Dhar and Simpson 2003; Hensher 2008; Swait and Adamowicz 2001) or the avoidance of choices (Dhar 1997). Boxall et al. (2009) found that respondents were more likely to select the status quo alternative as task complexity increased. (Complexity was defined by multiple attribute level changes occurring across all alternatives in a choice set as compared to single level changes.) There is mixed evidence about the influence on respondent behavior of the structure and dimensions of choice tasks. Some evidence suggests that the structure of choice sets in terms of the number of attributes and alternatives can impact on value estimates (Boyle and Özdemir 2009; Caussade et al. 2005; Hensher 2006, 2008) or serial non-participation (Rolfe and Bennett 2009; Von Haefen et al. 2005).

10.6 Framing Choice Tradeoffs

A key advantage of CM is that its rich statistical output allows insights into whether factors additional to the description of the scenarios and the socio-economic characteristics of respondents affect value estimates. CM has advantages in being able to present complex scenarios to respondents. Elements of complexity, such as the presence of complementary and substitute goods, can be incorporated into component attributes or tested through split-sample experiments (Rolfe and Bennett 2006). Framing problems occur when the respondent to a survey is sensitive to the context in which a particular tradeoff is offered in ways that are fundamentally different from the context of the actual policy issue being investigated. The presence of differential sensitivity creates risks that any subsequent benefit transfer process may be inaccurate if the frame varies between source and target sites. Three areas of focus for framing effects in benefit transfer relate to:

1. adjustments for scope factors;
2. variations in management policy; and
3. treatment of risk and uncertainty.

Each of these is discussed in turn.

10.6.1 Scope Adjustments

A particular area of interest for calibration in benefit transfer studies is the potential for scope effects, where unit values vary according to the amount of the amenity being valued and the extent of the context in which the amenity is being offered (Czajkowski and Hanley 2009; Johnston and Rosenberger 2010). Where the size of the tradeoff and its context are different between source and target studies, then sensitivity to unit value differences makes the benefit transfer process problematic without calibration (Rolfe and Wang 2011).

Many of the theoretical arguments and earlier tests with the contingent valuation method have focused on only one dimension at a time; however, emerging applications of CM (e.g., Lew and Wallmo 2011) allow both dimensions of scope to be tested. For the purposes of this study we distinguish between two types of scope effects: one where there are only changes in one attribute (a quantity or quality effect), and one where the dimensions of the tradeoffs occur (i.e. there are changes in the number or framing of the attributes). This is similar to the distinction made by Bateman et al. (2002), in which they identify changes in only one argument in the utility function as a scope effect, and changes in multiple arguments in the utility function as an embedding effect. Here we refer to them as quantity and dimension scope effects.

Economic theory predicts that larger amounts of a good are expected to have higher values than a lesser amount of the same good, but values for marginal changes are expected to be smaller for larger sized goods compared to smaller sized goods as a consequence of diminishing marginal utility (Hoehn 1991; Hoehn and Randall 1989). There may also be effects when there are changes in the frame or context of the amenity of interest as the dimensions of a good change, and hence the pool of substitute and complement goods that may be considered. The default assumption in the transfer of stated preference values is that quantity scope effects have little impact on marginal value estimates. This allows analysts to transfer unit values estimated, for instance, at one level of scope (e.g. a local river catchment) to target sites at different scope levels (e.g. a regional river catchment). If this default assumption does not hold, then benefit transfers across scopes should also involve some application of adjustment factors to take account of the impacts on unit value estimates (Johnston and Rosenberger 2010; Rolfe and Wang 2011; van Bueren and Bennett 2004).

The estimation of calibration factors for scope changes is complex. While there have been some case study calibrations (e.g. van Bueren and Bennett 2004) there has been no systematic approach to develop calibration factors that can be applied more widely. Rolfe et al. (2013) compiled the results of two case studies in Australia to develop a calibration factor that can be applied in BT related to the ratios of scope amounts. The authors found statistically significant correlation between the ratios of the quantities involved and the WTP estimates (expressed in log form) for each of the 41 different scope tests that were examined across two case studies.

10.6.2 Policy Options

Information about the policy used to achieve environmental protection outcomes is rarely included as a variable in CM. Some policy situations can be addressed with very different management strategies, and these may generate a range of other impacts (such as, restrictions of property rights, individual benefits and localized outcomes) independent of a cost variable. In such cases, people may have different preferences for environmental protection options that achieve the same outcome arising from different management strategies. In welfare terms, the utility of environmental protection options may be sensitive to the choice of inputs used to achieve the protection because those inputs may signal the presence of other positive and negative impacts on individual welfare. A number of studies have demonstrated that including information about management policy has a significant impact on values for environmental assets (Czajkowski and Hanley 2009; Hanley et al. 2010; Johnston and Duke 2007; Rolfe and Windle 2013).

In some situations, labeled alternatives may be a more appropriate mechanism for incorporating management policy scope into choice sets than the use of a separate policy attributes. A label is different from other attributes because it is independent from all the elements of the good, with responses depending on participant perceptions (Czajkowski and Hanley 2009) or emotional connection (Blamey et al. 2000) with the label. The use of labeled alternatives also means that levels for each attribute can be tailored to the relevant label, helping to represent case study scenarios more accurately (Rolfe and Windle 2013).

10.6.3 Risk and Uncertainty

There have been some attempts to incorporate information about outcome certainty into the design of CM. The goal has been to generate a more accurate depiction of choice alternative outcomes, particularly for scenarios with different likelihoods of occurrence, and to help make scenarios more realistic to respondents. There are two broad approaches to including information about output certainty into CM. The first is to provide general framing statements in the questionnaire that inform respondents that predictions about future environmental conditions are not necessarily certain. Studies that have tested this approach (e.g. Macmillan et al. 1996; Wielgus et al. 2009) have shown that WTP estimates for environmental attribute improvements are lower when the chance of occurrence is reduced.

The second broad approach is to include outcome certainty directly into choice experiments by incorporating certainty information into labels, attributes and levels. For example, Roberts et al. (2008) included different levels of uncertainty in the description of each of the two outcome attributes (algal blooms and water levels) and found that respondents' WTP was higher when information about outcome uncertainty was provided. Glenk and Colombo (2011) included outcome certainty as a separate stand-alone attribute focused on a valuation of the benefits of soil carbon sequestration in Scotland, with results showing that WTP estimates increased when an outcome certainty attribute was included.

10.7 Consistency of Values from Different Sources

Benefit transfer applications typically have poor theoretical foundations (Bergstrom and Taylor 2006; Johnston and Rosenberger 2010; Smith et al. 2002; Smith and Pattanayak 2002), particularly when values from different studies are combined, either as a compilation of point source transfers or in a meta-analysis. A key weakness is that values for commodities may not be consistent between case studies as a consequence of variations in the frame of the tradeoffs involved or where there are methodological differences between studies. This means that an assemblage of non-market values may not be consistent with individual utility functions (Johnston and Rosenberger 2010; Johnston and Thomassin 2010), particularly when point source values are amalgamated from different studies into a benefit transfer function. Smith et al. (2002, 2006) suggest initially setting a structured utility function as a framework, with transferred values then calibrated into that framework. This would minimize risks that assembled values are inconsistent.

The use of CM applications for BT can improve the consistency of values in two important ways. First, there is potential for CM applications to inform the setting of an initial structural utility function as suggested by Smith et al. (2002, 2006), essentially identifying the broad architecture of preference structures. Second, the multi-attribute nature of a CM means that values for labels and attributes are assessed in the context of the other elements of the choice set and background information, so that the frame for value discovery is more explicit. Further, the benefit transfer function can be wholly or partially transferred to the case study of interest with the potential to make some framing adjustments by accounting for site, population, and other differences. This means that the values generated in a CM are already consistent within the framework that has been established, and limits the amount of calibration required for values to be transferred into a structural utility function.

10.8 Conclusions

The richness of data available from CM applications has impacted on benefit transfer in a number of ways. Some of the impacts are in terms of precision, where the hedonic description of issues in terms of attributes, labels and levels provides a greater number of value estimates, while the benefit function derived from a CM application allows those values to be set in a more consistent framework. The substantial advances in statistical analysis have also helped to generate primary values that are more accurate and reflective of a wider array of causal factors.

Another key advantage of using CM results for BT is that they provide better insights into the validity and complexity of benefit transfer approaches. Transfer errors can be specified by attribute or population characteristics, by the choice processes or the error terms involved. Results from studies that have assessed the nature and extent of errors are helping to identify when benefit transfer works well, or where some form of adjustment is required. They also assist by providing estimates of adjustment coefficients. Insights into preference structures and the ability to transfer values or value functions that have already been framed in relevant settings help to minimize risks that an assembled transfer function will be inconsistent with utility preference structures.

Advances in the estimation of non-market value estimates come at a cost for BT applications. Improvements in precision or increases in the array of explanatory factors make it more difficult to transfer values between source and target sites, and make differences between study and policy site values more evident. Studies have clearly demonstrated that "one size does not fit all" when it comes to the use of CM-generated source values for benefit transfer across multiple target sites. There are ongoing challenges to identify how to vary the precision of BT estimates according to need, and where values need to be calibrated for BT purposes.

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