Fraser River Action Plan

A Critique of Analytical Approaches for Full Cost Accounting

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A CRITIQUE OF ANALYTICAL APPROACHES FOR FULL COST ACCOUNTING

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EXECUTIVE SUMMARY

The need for improved approaches to environmental decisions, particularly approaches for representing and balancing environmental values, has been widely discussed. The concept of "fidl cost accounting" as an approach to representing environmental values is introduced in a report by T. McDaniels (1994) for Environment Canada titled, "Building Full Cost Accounting into Resource Decisions for the Fraser Basin." The present repent is intended as a background document to the McDaniels (1994) report. his report discusses the complexities of applying analytical tools to represent societal environmental values in full cost accounting.

The purpose of this report is to provide a detaiIed review and critique of valuation approaches for full cost accounting. The discussion is fhrned in the context of wilderness preservation decisions, although the issues raised are relevant to all full cost accounting contexts. Two broad categories of value elicitation techniques have been developed in the literature and are considered here: (1) those based on the indirect revealed preferences of consumers in markets with related commodities; and (2) those based on the direct expressed preferences of individuals. This report reviews valuation methods within each category. The discussion is cast in terms of their potential for informing complex land use (or water use) decisions, particularly those involving wilderness values.

Indirect approaches outlined and assessed here are the contingent valuation method (CVM) and multiattribute utility technology (MAUT). Expressed preference techniques share the advantage of retaining flexibility to elicit values under a range of hypothetical scenarios. However, a number of significant errors and biases have been linked to the CVM. Its overriding weakness is that it typically requires holistic dollar measures for complex, incommensurable, uncertain and multidimensional values. MAUT represents a 'decomposition' approach which seems to be more in harmony with the constructive nature of human values and the coping strategies of respondents dealing with ' complexity. Although empirical evidence is sparse, there appears to be considerable scope for MAUT's use in allocation decision contexts.

1.0 INTRODUCTION

In British Columbia, the most intractable, polarized, complex and high-profile land-use conflicts have involved forested areas which are jointly valued by environmentalists and logging advocates. Although only a subset of the total land-use allocation conflicts in which the government, industry and various interest groups are engaged, the value-laden nature of these disputes brings into focus the central role that values play in imbuing an allocation decision with discord. Resolution of these and other value conflicts over forest resource issues depend in part on the explicit elicitation of values within a framework which balances costs and benefits.

Because many wilderness benefits are exogenous to the supply and demand functions of competitive markets, such values as recreation, aesthetic, existence, option, cultural, spiritual and ecological have no revealed prices to signal the quantitative strength of peoples' preferences for them. Other approaches must be used in such cases to address both the values of stakeholders and the complexities which form an inherent part of forest land use decisions.

The purpose of this paper is to describe the more widely documented non-market valuation [1] methods, outline the decisional settings in which each has been employed and highlight the strengths and weaknesses of each for clarifying the values associated with preservation decisions. The techniques classified here are arranged into two broad categories: indirect methods (which are based on individuals' revealed preferences) and direct methods (which are based on individuals' expressed preferences). The former set valuates benefits using surrogate markets, and includes the travel cost and hedonic price

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[1] *"Valuation" refers to the process and procedure of estimating the value of non-market goods and amenities, so as to provide a basis of comparison with the value of market items. "Value elicitation" and "evaluation" are used synonymously with valuation here. Comprehensive reviews of valuation methods are provided by Hufschmidt et al. (1983), Hyman and Stiftel (1987) and Braden and Kolstad (1991).*

methods. The latter set hypothetically valuates benefits, and includes the contingent valuation method and multiattribute utility approach.

2.0 INDIRECT NON-MARKET VALUE ELICITATION TECHNIQUES

In the absence of established market prices, it may be possible to estimate the value of a wilderness good or service indirectly by examining the price paid for a closely associated good or service that is traded in a market. In such cases, the value of these comparable commodities act as surrogates for their non-market counterparts. Because people's preferences are revealed through observation of their transactional behavior in markets, approaches based on surrogate prices are often referred to as revealed preference techniques. The most widely employed revealed preference measures of environmental extra-market values are based on travel costs and hedonic prices.

2.1 Travel Cost Method

Procedure

The most commonly used technique for inferring recreational demand is the travel cost method (TCM).[2] *The basic TCM developed by Clawson and Knetsch (1966) proceeds from the postulation that a recreationist would react equally to an increase in an entrance fee as to an increase in travel cost. The travel costs associated with a trip to and from a recreation site can therefore be used as a proxy for price in the derivation of a recreational site demand curve*[3] *(Sorg and Loomis 1984). The fees for park use are in most cases free (or nominal) and thus much lower than what an individual would be willing to pay. The difference between actual and maximum willingness to pay (WTP)*

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[2] *For thorough reviews of the TCM see Mendelssohn and Brown (1983), Rosenthal, Loomis and Peterson (1984), Anderson and Bishop (1986), Bowes and Krutilla (1989) and Forster (1989), as well as those listed under footnote 1.*

[3] *The demand curve refers to quantity demanded (i.e., number of visits) as a function of price (i.e., added cost per visit).*

payments is the net benefit (or net WTP) derived from a site, and is known as consumer's surplus. The travel cost approach uses the information on the pattern of recreational use of a park to derive a demand curve to estimate the total amount of consumer's surplus (Dixon and Sherman 1990).

The procedure begins with the collecting of data on the number of visits to a site and the origins of such visits. Visitor origins are then grouped into concentric zones[4] of varying distances from a site, with incurred travel costs increasing (and demand decreasing) as one moves from one zone to another away from the site. The visitation rate (visits per capita) and travel cost estimates to and from a site are calculated for each zone using the origin data (Forster 1989; Gunton 1991); the relationship between the two is a demand curve for the recreation experience (Hufschmidt and Hyman 1982).

The demand for the recreation site itself is a derived relationship between the total number of visits and a hypothetical set of entrance fees. The visitation rate in conjunction with socioeconomic information for each origin is utilized in a regression analysis to statistically estimate a first stage site demand curve. Regression analysis involves coalescing visits per capita as a function of trip cost or distance and socioeconomic data (Sorg and Loomis 1984). More sophisticated models can also reflect the value of travel time and be expanded to include substitute sites and quality indexes (Knetsch and Davis 1965; Braden, Kolstad and Miltz 1991). Total visitation from all relevant origins reflects demand at current travel costs and represents one point in the second stage demand curve at the prevailing admission fee. That is, it defines the intersection between the second stage demand curve and the nominal (should fees exist) or zero (should fees be absent) price line (Freeman 1979a; Greenley, Walsh and Young 1982; Hufschmidt et al.

[4] *The following approach is often called the zonal TCM (ZTCM) to differentiate it from the less common individual TCM (ITCM). In the ZTCM, recreationists are grouped into origin zones around a site, and a demand function is derived by estimating the statistical relationship between aggregate trips and travel costs from each zone. In contrast, the ITCM derives a demand function for an individual by estimating the statistical relationship between an individual's total tips in a given time period and distance travelled for such tips. Walsh (1986) and Bergstrom and Cordell (1991) elaborate on both.*

1983; Forster 1989).

The remainder of the second stage demand curve is generated by successively adding hypothetical entry fees to each origin's travel costs, in the assumption that visitors react to increased fees according to an estimated visitation response to increases in travel costs. Fees are increased until demand for park use, and thus the estimated number of trips by all individuals or from all distance zones, falls to zero. The per capita aggregate site demand curve is then used to estimate visits from each origin at each fee increment. The area under the resulting second stage demand curve plus any existent entry fees measure the recreation use value (i.e., total benefit or total WTP) attributed to the site. The difference in area between the total demand curve and fees represents the net benefit measure of total consumer's surplus (Greenley, Walsh and Young 1982; Walsh, Gillman and Loomis 1982; Hufschmidt et al. 1983).

Applications

The TCM was developed and applied for the valuation of recreation demand. Since its inception and period of development the TCM has been applied almost exclusively to outdoor recreation (Anderson and Bishop 1986). The procedure has been the preferred approach for estimating the benefits from recreation activities at specific sites, and has been found to work best for recreation areas of intermediate distances (100 to 150 miles) from the homes of most users (Walsh, Johnson and McKean 1990). The TCM can also be an acceptable way of estimating the recreation benefits which derive from specific activities or from changes in the quality of a site's resources (Rosenthal, Loomis and Peterson 1984; Ward and Loomis 1986). However, numerous stringent assumptions must be met and additional information taken before these latter computations can be successfully taken. As a result, the technique has been most widely used to infer a demand function for visits to a single-purpose, unitary site (Smith 1975; Bockstael and McConnell 198 1; Mendelssohn and Brown 1983).

Strengths

The main advantage of the TCM is that the secondary data required to calculate recreation demand is usually readily available. Consequently, such information as the number of visitors from each zone, length of stay, distance travelled and population per zone can be obtained relatively quickly and cheaply. Another strength of the TCM relates to its theoretical closeness to the market-based economic model. Because it uses actual consumer expenditures to impute non-market values it avoids some of the hypothetical value pitfalls attached to the contingent valuation method (Gunton 1991). Lastly, existing travel cost demand curves can normally be easily applied to a comparable site with minimal additional data collection. As such, developing a new travel cost model for each new site is not necessary in many cases (Dwyer, Kelly and Bowes 1977; Kaiser and Marchetta 1981).

Weaknesses

The literature cites numerous limitations and weaknesses in the use of the TCM. Principle among them are the difficulties in handling the cost of time, multi-destination trips, substitutes, congestion, quality changes and non-use values.

Time Cost

A major empirical problem with the TCM is the difficulty of accurately determining the true costs of travel. Besides out-of-pocket travel expenses, Knetsch and Davis (1965), Cesario and Knetsch (1970), Walsh, Gillman and Loomis (1982), Bowes and Krutilla (1989), among others emphasize the importance of including the. opportunity cost of time taken to travel to and from a site. Exclusion of time cost will result in an underestimate of site benefits (i.e., lower cpnsumer surplus). However, due to numerous complexities[5] surrounding the travel time concept, the opportunity cost of time cannot be easily measured. Correcting for this bias is therefore difficult, and at this time no

[5]*See Cesario (1976), Bishop and Heberlein (1979), Hufschmidt et al. (1983) and Hyman and Stiftel (1988) for the problems in and possible means of incorporating the costs of travel time into the TCM.*

universally accepted formulation exists to accurately account for it in a TCM framework (Smith, Desvousges and Fisher 1986; Gunton 1991).

Multiple Destination/Purpose Trips

Many recreationists visit more than one site when traveling. This is particularly true for long trips where numerous recreational sites exist between the zone of origin and the site under study (Hufschmidt et al. 1983). Allocation of the full costs associated with a multi-destination trip exclusively to the examined recreation site biases the measured demand for a site's benefits upwards (Haspel and Johnson 1982; Gunton 1991). The travel costs should under such circumstances be divided between the various sites visited[6] (Smith and Kopp 1980).

Relatedly, multi-purpose trips (where more than one recreational activity is sought at a site) poses computational complexity and increases the likelihood of bias. Data collection is also problematic for sites which have widely separated, multiple entry points. In addition, the journey itself may provide travelers utility or disutility beyond those attributed to the costs of travel and time. When the underlying TCM assumption of pure visitation (site-specific, single purpose travel) is not met, much more extensive ,data collection[7] will be required to overcome these problems (Kaiser and Marchetta 1981; Hufschmidt et al. 1983).

Substitutes

Alternative sites with comparable attributes are often available to recreationists as substitutes. However, substitute sites are often ignored in travel cost evaluations, which tends to result in an overestimate of the benefits attached to the primary site

[6]*Beardsley (1971) and Haspel and Johnson (1982) provide alternative ways of divvying up costs between two or more visited sites, with the former allocating costs in proportion to the relative amounts of time spent at each and the latter dividing costs evenly between each.*

[7]*This may include in some cases visitor surveys. As Gunton (1991, 17) points out, however, "...if surveys are used, willingness to pay questions might as well be employed."*

(Swanson and Peterson 1988; Forster 1989). A more complex, data-intensive multi-site travel cost model must be employed in regions with complementary substitutes in order to provide more realistic benefit estimates.[8]

Site Congestion and Quality

Increased density of recreation use may crowd a site to a point where the quality of the recreation experience diminishes. The conventional TC demand curve, however, implicitly assumes that recreational quality remains constant over the full range of use levels (Bishop and Heberlein 1979). Refinements in the model are necessary for evaluating the effects of congestion on site benefits (Newberry 1975). However, there is little agreement in the literature on how to account for the costs of congestion in the TCM and modelling its effects with aggregate data is not easily accomplished (Forster 1989).

Other qualitative and quantitative attributes of a site are also difficult to model. For example, extracting information on site characteristics with multiple attributes adds increasing levels of difficulty and cost to an assessment. Although such adjustments to the simple TCM as the hedonic TCM[9]*, devised by Mendelssohn and Brown, have been used to reveal users' WTP for individual recreational site characteristics, measurement difficulties persist. Aesthetic and spiritual values for example, although dominant features in many people's total recreational experience, remain extremely difficult to measure inferentially. Adjustments are also required to improve 'the TCMS application in the presence of qualitative and quantitative changes to a site (see Smith, Desvousges and Fisher 1986). A composite value representing all of the activities on a site may fail to*

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[8] *See Cesario and Knetsch (1976), Anderson and Bishop (1986), Rosenthal (1987) and Forster (1989) for examples of regional TCMS which incorporate substitution effects.*

[9] *1n addition to Mendelssohn (1983) and Brown and Mendelssohn (1984), see Smith and Kaoru (1987) and Mendelssohn and Markstrom (1988) for overviews and assessments of the hedonic TCM. Brown and Mendelssohn (1984, 427) describe in general terms how site characteristics are derived in the HTCM: "The prices of recreation attributes are estimated by regressing travel costs on the bundles of characteristics associated with each of several potential destination sites. The demand for site characteristics on site quality is then revealed by comparing the site selection of users facing different attribute prices."*

appropriately reflect the different responses of each activity to changes in various site characteristics (Forster 1989).[10]

Non-Use Values

Because the TCM measures costs associated with actual visits to a site, it is limited to measuring use values only. It therefore can understate the value of a site by excluding non-user benefits such as existence, bequest, option and ecological values (Swanson and Peterson 1988; Gunton 1991; McCollum and Bergstrom 1992).

Other Weaknesses

A number of other drawbacks have been cited for the TCM. Along with being an inappropriate approach for sites which heavily attract very distant travelers who make numerous stops, it has been found to underestimate demand for sites which are surrounded by a dense population of proximate users. Although travel costs tend to be very low under such circumstances, people may highly value the natural amenities supplied by a recreation area; in fact, such amenities may have attracted people to locate in a scenic area in the first place, even if it means increasing their commuting costs to work. Also, a densely populated region which has residents with relatively uniform recreational travel expenses obstructs an analyst's ability of generating a demand curve because not enough data points can be induced (Hufschmidt and Hyman 1982; Hyman and Stiftel 1988).

The assumption that people treat travel costs and entrance fees identically has been questioned in the literature as well. The effects of the multiple destination bias on this assumption has already been alluded to. In addition, Bishop and Heberlein (1979, 926-7) view travel costs as an inaccurate proxy of site fees in many cases, as indicated in the following quotation:

Travel costs represent an aggregation of many smaller costs, some of which (e.g.,

[10]*Sorg and Loomis (1984) provide empirical estimates of various individual recreation activities using, along with other methods, the TCM.*

> *tire wear) may not be obvious to the recreationist and which are not actually imposed on the recreationist at the time when recreation is demanded. Admission fees are paid immediately, usually in cash. Particularly in a world of satisficing, travel costs may not be perceived as equivalent to admission fees.*

Consequently, people often underestimate the costs of automobile travel (Common 1973).

Income effects may also bias valuation results by undermining the travel cost proxy assumption. The TCM assumption that people in all distance zones monetarily value the same quantity of recreation equally was criticized by Seckler (1966), who argued that systematic variations in incomes and utility functions between zones may exist. In such cases, individuals within groupings based on shared distances may have less in common in terms of tastes and preferences than individuals within similar income brackets (Pearse 1968). In the absence of systematic income differences between zones, socioeconomic heterogeneity within zones alone violates the uniform preference assumption. Although socioeconomic data have been included in numerous TC frameworks to help abridge the problems associated with these assumptive breaches, Hufschmidt et al. (1983) conclude that such inclusions have only met with varying degrees of success.

Other fixed assumptions in the TC model which may be at odds with actual conditions are that (1) the singular purpose of the trip is for recreation [11], (2) the amount of time spent at the site is the same for all users, regardless of distance travelled and (3) the identical mode of transportation is utilized for all trips (Hyrnan and Stiftel 1987). To improve the likelihood that these assumptions (along with the single-destination assumption) actually exist, Smith and Kopp (1980) recommend that a cut-off distance should be set for the furthest zone. As stated earlier, one' distance range which has been suggested as optimal for many TC studies is 100 to 150 miles (Walsh, Johnson and

[11] *Or at the very least a recreation site must be a necessary part of the visit, or if as economists call it, a "weak complement". Otherwise, transportation demand does not capture all of the demand for recreation (Braden, Kolstad and Miltz 1991).*

McKean 1990). However, for many sites, travelers originate further afield, and setting an arbitrary distance limit will only prevent the preferences of such recreationists from being revealed in a TC exercise (Johnson 1980).

Overall, the TC approach has many shortcomings which diminish its applicability in valuing wilderness extra-market benefits. In the case of non-use values, its failings are complete in that the technique provides no assistance. As well, unless a site has only one, identifiable wilderness value (or a composite measurement is satisfactory) the method fails to provide realistic measures of individual use values within a multi-attribute area. In principle, many problems surrounding the valuation of recreation benefits can be overcome by expanding the TC analysis beyond the traditional Clawson approach through increased levels of data collection on visitor preferences and itineraries. However, in practice such adjustments have not provided adequate scope to iron out the more serious flaws in the approach. The TCM remains on fm methodological footing only when the stated assumptions of human behavior and measured variables are met.

2.2 Hedonic Price Method

Procedure

Another prevalent indirect elicitation procedure is the hedonic price method (HPM).[12] *The HPM infers the demand for non-market values by estimating implicit prices for individual attributes of a market commodity. The approach rests on the notion that some environmental goods and services are attributes of market commodities (Braden, Kolstad and Miltz 1991). Property value is the most notable example of a commodity whose price is determined in part by the aggregated bundle of non-market goods and flow of non-market services which help to form the character of a property. The property value method uses real estate price differences between similar properties as a*

[12] *Good sources for the procedure, use and assessment of the H.PM can be found in Rosen (1974), Harrison and Rubinfeld (1978b), Freeman (1979b), Nelson (1978), Anderson and Bishop (1986) and Bowes and Krutilla (1989), as well as those listed under footnote 1.*

measure for the value of the one environmental quality attribute which differs between them (OECD 1989; Pearce, Markandya and Barbier 1989). Any changes in property prices can reflect quantitative or qualitative changes in any one of the property's characteristics, including in the encroaching environmental attributes. The property method can also capture these changes. It has been most widely applied in determining the value of ambient air quality in residential areas, but has also been used for valuing scenic vistas, noise, proximate natural areas, among other extra-market variables (Hufschmidt et al. 1983).

Although most hedonic evaluations have used property values as surrogates for non-market good and service prices, the HPM can presumably be used for any good or factor of production which contains environmental attributes as one or more of its numerous characteristics. For example, Gunton and Vertinsky (1990, 15) illustrate in general terms the possible use of hedonic pricing. for valuing the natural features of a recreation facility:

> *The price of, a good is a function of a bundle of attributes. The value of a recreation site, for example, is a function of a number of factors such as distance, facilities, availability of recreation activities, environmental quality and, scenic value. The difference in atrnbutes allows for the valuation of specific features by using statistical methods to assess the impact of each individual characteristic. For example, a site with good fishing can be compared to other sites which are similar in all nxpects other than the availability of good fishing. The difference in price can then be used to estimate the value of fishing.*

Economists use hedonic studies to ascertain the underlying demand for such characteristics by statistically analyzing the effects of them on the price of a good or factor (Palmquist 1991). The implicit prices of the individual attributes themselves reflect similar supply and demand forces as the observable commodity prices. Such implicit prices must therefore be tied to consumer tastes and preferences in order to generate an attribute demand function that can be used to make singular attribute value measurements (Braden, Kolstad and Miltz 1991). The demand curve can also be used to calculate the

benefits or losses that occur as a result of marginal changes in the quality or supply of an environmental attribute (Hufschmidt et al. 1983).

Applications

The HPM was initially developed by Griliches (1961, 1971) to assess the impacts of quality improvements in consumer goods on their value. The first study which attempted to use residential property values to infer environmental values was undertaken by Ridker (1967) and Ridker and Henning (1967).

The property value method has since been used to estimate the effects of air quality (Harrison and Rubinfeld 1978a, 1978b; Nelson 1978; Freeman 1979a, 1982), water quality (Lind 1973; Brown and Pullakowski 1977), noise pollution (Pearce and Edwards 1979), aesthetic values (Armstrong 1974; Sinden and Worrell 1979) and improvements and damage to local amenities (Armstrong 1974; Polinsky and Shaven 1976; Abelson 1979; Bartik 1988) on property values.

As previously mentioned, the HPM has also been hybridized with the TCM to ~ estimate the benefits and costs of congestion, quality differences and changes and other recreation site attributes.

Strengths

The main strength of the HPM is that, like the TCM, actual market transaction data are used to estimate non-market values. Using observed market behavior eliminates ‘ any confusion between the intentions and actions of consumers because only actual transactions are studied (Braden, Kolstad and Miltz 1991); it is thus less prone to the systematic biases that may plague hypothetical valuation measures (Hufschmidt et al. 1983; Hyrnan and Stiftel 1987). Unlike the simple TCM, the HPM is specifically designed to evaluate environmental quality and atrnbutes. Consequently, it is theoretically possible using the technique to infer demand for non-marketed commodities from markets with related commodities (Braden and Kolstad 1991).

Weaknesses

Hedonic approaches share some serious assumptive limitations with travel cost approaches. Firstly, the weak complementarily relationship must hold between the atrnbute and its associated commodity; that is, marginal utility can only be derived from an extra-market good if a certain amount of a market good is also consumed. Secondly, any changes which occur in an attribute are assumed to be fully absorbed in the price or quantity of its weak complement. This assumption does not hold for many complementary goods. Lastly, like any revealed preference approach, the HPM cannot measure non-use values (Braden, Kolstad and Miltz 1991).

The approach also has some unique problems. One very serious difficulty with the procedure is that it relies on the assumption that sufficient information exists for the various variables which affect commodity prices. Because sufficient market data often are not available to identify all significant variables, bias can be introduced into the analysis ~ when relevant variables are excluded and unreliable estimates can occur when irrelevant variables are included. Though obtaining precise data on the price of a distinct commodity is problematic, data are particularly difficult to procure and measurements difficult to take for the myriad of variables that determine price. This is especially true for the environmental variables that need to be captured in the procedure. All in all, measurement and data elicitation impediments abound in the HPM. (Pearce, Markandya and Barbier 1989).

Relatedly, the underlying price relationships have a diversity of possible formulations, each of which give different results. In most cases, the real relationship between the dependent variable (commodity price: e.g., housing) and independent variable (attribute affecting commodity price: e.g., pollution level) is not known, and clear guidelines do not exist for choosing the functional form statistically relating the two (Freeman 1979b; Gunton 1991). Isolating the effect of a singular attribute on the

immediate value of a dependent variable is compounded in complexity by the expectations of future trends, which are inextricably capitalized into existing prices (Gunton 1991).

Another statistical pitfall relates to the highly correlated nature of environmental attributes. In practice, disaggregating every attribute from an integrated whole in the effort of measuring and regressionally linking each to the dependent variable is not possible in most cases. To ease the complexity of this step, proxy or aggregate variabIes are normally used, possibly concealing the attribute of concern. The accuracy of the hedonic method's results is very sensitive to this exercise (Pearce, Markandya and Barbier 1989). This stage of the procedure also depends on the knowledge base of the consumers making up a hedonic study. Because the HPM can only capture the attributes that are known to commodity users, values of characteristics that exist but are not perceived (or at least not perceived in reference to the dependent variable) remain unmeasured. Insufficient information and imperfect perception on the part of the consumer violates the HPMs assumption of a perfectly functioning market and promotes inaccurate attribute assessments (Mendelssohn and Markstrom 1988; McCollum and Bergstrom 1992).

Most of the literature on hedonic prices has been orientated towards using property prices as an inferential measure of marginal changes in environmental quality, mostly air pollution. As a result, property values, though often inaccurate surrogates, are the most fully fleshed out hedonic prices in theoretical and practical use. However, wilderness is more often than not remote, and as such has little effect on residential housing markets. Other commodity prices must be used in such instances to reveal how much users are willing to pay for the individual characteristics of natural sites. Other than hedonic travel costs, the literature on hedonic approaches provides' few examples of alternative surrogates which can derive meaningful measures of non-market wilderness values. These and other weaknesses limit the HPMs usefulness for determining the

value of wilderness and other non-market resources.

3.0 DIRECT NON-MARKET' VALUE ELICITATION TECHNIQUES

Another way of measuring extra-market values is to involve participants directly in either a hypothetically-derived market or public involvement process. Because people's preferences are actively sought out and explicitly expressed in these forums, approaches based on the direct elicitation of values are often referred to as expressed preference techniques. The expressed preference-based procedures outlined here are the contingent valuation method, which (like the TCM and HPM) is a tool within benefit-cost analysis, and the multiattribute utility technique, which stems from normative and behavioral decision theory.

3.1 Contingent Valuation Methodd Procedures

The contingent valuation method (CVM)[13] *has been proposed as a popular alternative when the assumptions of revealed preference techniques cannot be met. The CVM allows people to provide direct expressions of preferences for non-market resources by asking them what they would be willing to pay for a benefit or what they would be willing to receive by way of compensation to tolerate a loss for a hypothetical market scenario. Benefits and costs are respectively presented as increments and decrements in the quantity or quality, or both, of targeted resources. In most cases, willingness to pay (WT.P) questions are fiarned in a manner which elicits the maximum an individual is willing to pay for specified improvements or increases in an unpriced good or service. Less commonly, they can ask for an individual's maximum WTP to prevent a deterioration or reduction in an unpriced resource. Willingness to accept (WTA)*

[13] *Cummings, Brookshire and Schulze (1986) and Mitchell and Carlson (1989) are two volumes which offer detailed procedural outlines and assessments of the CVM.*

questions, on the other hand, ask respondents to give the minimum amount of compensation that they would demand in order to accept a given deterioration or diminishment in an extra-market resource (Randall, Hoehn and Brookshire 1983; Forster 1989; Pearce, Markandya and Barbier 1989; McCollum and Bergstrom 1992).

The contingent values are obtained either through a direct questionnaire/survey or through the use of experimental techniques in which subjects respond to a variety of controlled stimuli in laboratory conditions, with the former being the more prevalent approach. What are sought are the personal valuations of the respondents for specific levels of or changes in a good or service, expressed in WTP or WTA dollar amounts (Pearce, Markandya and Barbier 1989). The elicitation procedure is called the contingent valuation method because the elicited WTP (or WTA) values are contingent upon the specific hypothetical market described to the respondent (Mitchell and Carson 1989). In general, the value of the good or service is estimated by multiplying the average of these expressions of value by the number of consumers (Gunton 1991).

Mitchell and Carson (1989, 3) describe a typical CVM, which generally consists of three parts:

> *1. A detailed description of the good(s) being valued and the hypothetical circumstances under which it is made available to the respondent. The researcher constructs a model market in considerable detail, which is communicated to the respondent in the form of a scenario that is read by the interviewer during the course of the interview. The market is designed to be as plausible as possible. It describes the good to be valued, the baseline level of provision, the structure under which the good is to be provided, the range of available substitutes, and the method of payment. In order to trace out a demand curve for the good, respondents are usually asked to value several levels of provision.*
> *2. Questions which elicit the respondents' willingness to pay for the good(s) being valued. These questions are designed to facilitate the valuation process without themselves biasing the respondent's WTP amounts.*
> *3. Questions about respondents' characteristics (for example, age, income), their preferences relevant to the good(s) being valued, and their use of the good(s). This information, some of which is usually elicited preceding and some following reading of the scenario, is used in regression equations to estimate a valuation function for the good. Successful estimations using variables which theory identifies as predictive of people's willingness to pay are partial evidence*

for reliability and validity.

Several survey approaches have been employed in contingent valuation studies to elicit values from a subject (stage 2 above). Among the most common ones are the open-ended method, the iterative bidding method, the payment card method and the dichotomous choice method. Each of these are described and assessed in general terms below. A more extensive assessment of the advantages and disadvantages of the CVM will follow the discussion on its applications.

Open-Ended Method

The simplest format in which to obtain contingent value data is the open-ended method. Following a description of the product and means of payment (often referred to as payment vehicle), respondents are asked directly to give their maximum WTP or minimum WTA[14] for an environmental good or service.

Its simplicity makes the approach amenable to mail surveys. Another advantage is that it avoids the response influences which are associated with the provision of starting bids or increments (Anderson and Bishop 1986; Forster 1989). A couple of criticisms have been laid against this approach. First, because very little information or stimuli is provided to encourage thorough consideration of a resource's value, respondents with little experience or knowledge will not be able to accurately estimate the value of such a resource. Consequently, respondents often have very little incentive in such hypothetical markets .to devote serious effort in formulating correct responses. Second, with no specified prices to guide consumer choice, this method does not simulate market behavior very well. The net result is that people often find it difficult to answer questions of this type. People facing such difficulties may potentially provide no response at all or give answers which are implausibly high or low (Carson 1991).

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[14] *To simplify the following discussion WTP will be used to represent both WTP and WTA.*

Iterative Bidding Method

The iterative bidding game is the oldest and most frequently used CVM. The first stage, like all CV studies, provides a description of the non-market item and a hypothetical market in which the item is traded to a respondent. Iterative bidding begins with a suggested initial starting bid. If the respondent is willing to pay the starting bid, the interviewer suggests a higher bid. A series of revisions upwards takes place until the respondent is unwilling to pay. If the the initial bid is unacceptably high for the respondent, the interviewer progressively revises the bid downwards until an acceptable dolktr figure is found. The accepted final bid is the measure of the respondent's maximum WTP for the item being evaluated (Sorg and Loomis 1985; Boyle and Bishop 1988).

The main advantage of the iterative process is that it is said to help respondents to more fully contemplate and evaluate their preferences and thus presumably provides a relatively more realistic maximum WTP measure (Randall, Ives and Eastman 1974; Cummings, Brookshire and Schulze 1986). However, this advantage may be partly offset by the potential of the initial bid provided by the interviewer to influence the final bid provided by the respondent (Boyle, Bishop and Welsh 1985).

Payment Card Method

A recent approach developed by Mitchell arid Carson (1981) is the payment card method. After the non-market good and hypothetical market are described, a subject is asked to provide information on his income. He is then presented with a payment card which portrays a range of dollar values starting at zero and increasing at fixed intervals. The card corresponds to the respondent's household annual income and shows estimates (anchored figures) of what people at his income level paid, through taxes, for selected publicly provided goods. The subject is then asked to state, after considering the information on the card and his income level, a maximum amount he would pay for the non-market good in question. With no bidding involved, the response is considered final

(Boyle and Bishop 1988; Mitchell and Carson 1989; McCollum and Bergstrom 1992).

Anchored payment cards were initially developed by Mitchell and Carson in an attempt to generate results not tainted by starting bid biases. Proponents argue that the approach accomplishes this promise while retaining all the advantages of iterative bidding (Mitchell and Carson 1981, 1989). However, questions remain as to whether or not the range of anchor point values provided on the card; along with the other information, prejudices responses to CV questions (Boyle and Bishop 1988).

Dichotomous Choice Method

The frost phase of the dichotomous choice method begins as all other CV exercises do (as described under the preceding methods). Respondents are then asked whether or not they are willing to pay some specified amount for a non-market good rather than do without it altogether. This take-it-or-leave-it or close-ended strategy does not permit respondents to state their own specific dollar values. With different respondents being given different dollar amounts to respond to, a series of rejection and acceptance subsamples are used in a discrete choice model. The model in turn estimates the probability of acceptance as a function of the stated price and other variables. The estimated probability distribution is then used to calculate the mean or median value of the elicited good or service (Bishop and Heberlein 1979; Loomis 1988; McCollum and Bergstrom 1992).

Advantages of this approach are that it can be readily applied in a mail survey format, encourages responses and is free of starting point bias (Duffield and Patterson 1991). It also more closely resembles market transactions in which people either purchase or don't purchase goods at presented selling prices (Bishop and Heberlein 1986). Unlike the inrncacies of anchored payment cards and the complexities of bidding formats, survey subjects only have to respond with a yes or a no to a presented price. Offering a conceptually simpler fixed amount to respond to avoids the problem of having

subjects attach specific dollar values to monetarily' ambiguous environmental commodities (Boyle and Bishop 1988; Cameron 1991). The approach has some downfalls however. Foremost among them is the high level of statistical sophistication which is required to analyze qualitative responses (yes/no) to valuation questions. Because a larger number of observations are needed to achieve a level of statistical reliability matching those of other techniques, it is also more data intensive and expensive (Mitchell and Carson 1989). In addition, qualitative answers convey less information on respondents actual preferences than the former two approaches (Boyle and Bishop 1988; Carson 1991).

Applications

The CVM has been used to elicit values in a broad range of studies for a broad range of resource values. [15] *Davis (1963) was the first to apply the approach when he used it to estimate the demand for outdoor recreation in the United States. It has since been employed to measure many recreational activities*[16] *including a total recreation experience (Menz and Mullen 1981), camping (Walsh, Aukerrnan and Milton 1980), fishing (Walsh, Aukerrnan and Milton 1980; Sorg et al. 1985; Cameron and James 1987) and hunting (Cocheba and Langford 1978; Brookshire, Randall and Stoll 1980; Sorg and Nelson 1986; Bishop and Heberlein 1986). In addition, the CVM has been employed in numerous environmental (Greenley, Walsh and Young 1981; Jackson 1983) and a few aesthetic (Randall, Ives and Eastman 1974; Brookshire, Ives and Schulze 1976) quality studies.*

The literature also cites CV exercises which have measured non-use values of wilderness. Included here are valuations of wilderness preservation[17] *(Walsh and Gilliam 1982; Walsh, Loomis and Gillman 1984, 1985; Willis 1989; Walsh et al. 1990),*

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[15] *Carson (1991, 124-6) and Randall (1991, 221-5) provide literature reviews on numerous CV studies, with the latter also reviewing those which compare the CVM with the TCM and HPM.*

[16] *Sorg and Loomis (1984) review numerous CVM and TCM studies on a diversity of recreation activities, including hunting, camping, fishing, hiking; picnicking and wilderness.*

[17] *Both the wilderness and water quality preservation studies included measurements of option, existence, bequest and use values.*

water quality preservation (Greenley, Walsh and Young 1981, 1982), existence values[18] of wilderness (Bennett 1984) and wildlife species (Brookshire, Eubanks and Randall 1983; Stevens et al. 1991) and option values of wilderness (Ba.mick 1985; Barrick and Beazley 1990) and wildlife species (Brookshire, Eubanks and Randall 1983). It has further been used to measure the non-consumptive use values and non-use values people derive from preserving such rare or endangered species as the northern spotted owl (Rubin, Helfand and Loomis 1991), the bald eagle (Boyle and Bishop 1987), the grizzly bear (Brookshire, Eubanks and Randall 1983) and the whooping crane (Stoll and Johnson).[19]

Strengths

The fundamental advantage of the CVM over revealed preference approaches is that it is not confined to evaluating non-market goods and services which have related surrogates in the marketplace. This imbues the technique with a relatively high degree of flexibility. Not being reliant on observed market behavior or availability of actual resource conditions, CV studies can estimate benefits under a wide range of hypothetical scenarios. It can thus be used to estimate the value of numerous attributes of interest, such as specific types of outdoor recreation and aesthetic benefits of the natural environment. Unlike revealed preference measures, the CVM can be used to measure people's expressed preferences for the non-use, preservation values associated with the mere existence of a wilderness area and the options which are generated from retaining such areas (Greenley, Walsh and Young 1982; Anderson and Bishop 1986; McCollum and Bergstrom 1992).

The CVM'S flexibility also permits it to be modified to incorporate alternative

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[18]Brookshire, Eubanks and Sorg (1986, 1987) describe and assess numerous CV studies on the existence values of wilderness and species.

[19]Gregory, Mendelssohn and Moore (1989) describe and assess some of these (as well as other) CV studies on endangered species.

situations, such as different payment vehicles, market structures, tradeoff scenarios and qualitative and quantitative changes (Gunton 1991). Furthermore, it can be adapted to measure the values associated with the impacts of specific proposed policies (Swanson and Peterson 1988). Lastly, the CVM is said to be consistent with individual choice and welfare measurement theory (Smith 1987).

Weaknesses

Numerous potential biases and other. problems have been cited that may undermine the validity (i.e., accuracy) and reliability (i.e., reproducibility) of the CVM. Distortions arising from biased responses to questionnaires and interviews have received particular scrutiny in the literature. Distorted expressions of preferences are said to produce biased results as opposed to mere confusion when deviations from statistical predictions are systematic rather than random (Gregory 1982).

This section will provide an overview of many of these biases as well as other difficulties, beginning with those that are specifically correlated with the CV procedure and ending with those that are generally linked to the relationship between the cognitive processes of the respondents and the context set by the scenario and questions in the CV procedure. Included in this discussion are WTP versus WTA disparities, design biases (which stem from the characteristics of the questions asked), motivational biases (which are intentionally injected into the measurement procedure) and cognitive biases (which are unintentionally introduced distortions). First, however, the overriding issues of validity and reliability concerns are raised.

Testing Validity and Reliability

As contingent valuations have become more refined, the literature has reflected an increasing concern over the limits of its application. Such concerns have focused attention on the overall validity and reliability of elicited contingent values and the means of testing for their existence. Validity studies for example are designed to determine whether the statistical expectation of an estimated mean is equal to the true mean of the item being

evaluated; these test for accuracy in the elicited values. Reliability studies, on the other hand, are designed to ascertain whether the estimated contingent values are equivalent between successive applications of the same CV procedure across time; these test for consistency, or reproducibility, of elicited values (KeaIy, Montgomery and Dovidio 1990 Reiling et al. 1990).

Predictive validity, which refers to how closely the contingent value of the good matches the value of the good were it to be traded in an actual market, is tested by comparing the WTP measure of the public good with the value of a highly correlated private good. However, in the case of public goods such markets generally do not exist, making such comparisons difficult, if not impossible (Kealy, Montgomery and Dovidio 1990).

As an alternative to actual market comparisons, testing for validity is normally inferred by comparing contingent values with values procured through procedures based on the observation of actual behavior, such as simulated markets, the TCM or the HPM (Kealy, Dovidio and Rockel 1988; Reiling. et al. 1990). Because such inferential procedures assess the convergence between the results of the CVM and indirect methods, the validity which is tested for is often referred to as convergent validity, and many examples of this type of research can be found in the literature.[20]

These studies have determined that reasonable convergence occurs between the results of the CVM and indirect approaches. However, Cummings, Brookshire and Schulze (1986) and Mitchell and Carson (1989) caution that such results are only suggestive and not definitive reflections of validity. The reason that validation of contingent values cannot be assessed in most cases is that non-market valuation techniques provide an abstract measure of an individual's true preference, not a

[20]*See Knetsch and Davis (1966), Bishop and Heberlein (1979), Sellar, Stoll and Chavas (1985), Smith, Desvousges and Fisher (1986) (TCM comparisons), Brookshire et al. (1982) (HPM comparisons), Bishop, Heberlein and Kealy (1983), Heberlein and Bishop (1986) and Kealy, Dovidio and Rockel (1988) (simulated market comparisons).*

benchmark market value to which a more concrete comparison can be made. In other words, each technique provides an alternative measure of the same underlying construct (Mitchell and Carson 1989; Gunton 1991).

As a result, a contingent value, which in social psychological terms is a measure of behavioral or attitudinal intention (Heberlein and Bishop 1986), is a hypothetical value which in most non-market circumstances cannot be compared, and thus validated, with the true preferences of respondents, which lie buried in often poorly delineated value systems. As Carson (1991, 136) points out, "...no applicable body of theory exists by which validity can be assessed because there are no explanatory models of the cognitive processes that underlie respondents' verbal reports.[21] *TheConfidence in the validity (and reliability) of estimated values tend to be particularly fragile and tentative when ill-defined, unfamiliar goods are being evaluated. Convergence, therefore, will be weaker for less tangible, more amorphous goods and services (Cummings, Brookshire and Schulze 1986; Kealy, Montgomery and Dovidio 1990), such as the human spiritual and ecological values commonly linked to natural areas.*

Reliability refers to the variation in the estimated contingent values due to random sources, or 'noise'. Mitchell and Carson (1989) identify three potential sources of variation in contingent values: (1) actual variation in values across the population being sampled; (2) variation resulting from the specific contingent valuation procedure employed and (3) variation arising as a result of the small size of the population being sampled. Refining the design features of the CVM can be undertaken in an effort to reduce the imprecision which stems from the latter two sources of variation (Reiling et al. 1990).

Most of the reliability tests which have been undertaken have evaluated the stability in responses over time and whether or not response fluidity, if it exits, is dictated by such potential influences as the nature of the good (Kealy, Montgomery and Dovidio

[21] *The "Cognitive Biases" section elaborates more fully on cognitive-based difficulties.*

1990) or the seasonal timing of application of the survey (Reiling et al. 1990). Assessing whether or not the findings in a specific CV study (source (2) above) are consistent is normally accomplished through the employment of test-retest or multiple replication procedures, where the same sample of individuals respond to the same valuation questions at two or more distinct time periods. A sampling of the literature shows that a few studies have been undertaken in this manner to assess the reliability of CV measures across time.[22]

Results from these studies suggest that the CVM does indeed provide statistically reliable estimates of value. However, like the validity studies, results from the reliability studies are suggestive only, and thus can not be generalized to any great extent. Reiling et al. (1990), for example, state that past efforts at assessing the reliability of hypothetical values lack generalizable utility because they either value a market good only (e.g., Kealy, Dovidio and Rockel 1988) or because their survey response rates are low (e.g., Loomis 1989). They recommend that future tests concentrate on the reliability of specific CV survey components and non-use values, both of which may influence to a considerable degree the reliability of the overall contingent value estimates. Until a greater number of tests like these are undertaken and their results verified with each other and other studies of similar goods, it cannot be determined whether CV estimates are reliable or not (Hyman and Stiftel 1988).

As a result of disagreements over whether validity and reliability concerns are justified or not, it is not known at this point if Cummings, Brookshire and Schulze's (1986) conclusion that CVM estimates are accurate with plus or minus 50 percent of market value is a believable assertion or not. Although no definitive determination has yet been made on the consistency and accuracy of the CVM, the literature cites many potential difficulties with the approach that accent the concerns which have been raised over validity and reliability issues. It is to these weaknesses that we now turn our attention.

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[22]*Kealy, Dovidio and Rockel (1988), Loomis (1989), Kealy, Montgomery and Dovidio (1990) and Reiling et al. (1990) provide good examples of how reliability can be tested.*

Willingness to Pay / Willingness to Accept Discrepancy

The traditional approach used by researchers to measure benefits is to estimate some form of an ordinary demand curve from which the Marshallian measure of consumer surplus[23] can be obtained. Although simply derived in that it avoids the problem of assigning appropriate property rights, such an avoidance makes it a non-reflective measure of an agent's welfare change. CV researchers are thus forced to make a decision on which Hicksian measure of consumer surplus, WTP or WTA, to use for a given welfare change. The question of property rights is the overriding determinant of which formulation to choose, in that WTP represents the buyers perspective and WTA represents the sellers (owners) perspective. Although property rights from both perspectives are more perceived than actually legal within a CV framework, their real or imagined influence on the views of respondents and their corresponding WTP or WTA answers have promoted a wealth of debate in the economic literature on which or either is the appropriate measure (Mitchell and Carson 1989).

Established theory in welfare economics suggests that both WTP and WTA are commensurably viable measures of consumer surplus because they are approximately equal. Developed by Willig (1976) for price changes and Randall and Stoll (1980) for quantity changes, the stated theoretical assertion is that individuals are willing to pay the same amount of money for marginal increases in consumption as they would be willing to accept by way of compensation for an identical decrement in consumption. Providing income effects are negligible and compensation entitlements do not notably increase real wealth, the theory should hold and the choice of measure should not be of significant concern (Willig 1976).

In contrast with the theoretical axioms which predict only small WTP-WTA disparities, empirical evidence from a wide range of CV studies[24] show significant

[23] *Consumer surplus in this context is defined as the area under the ordinary (Marshallian) demand curve and above the price line.*

differences between WTP and WTA, with WTA far exceeding WTP in most cases. The consistency of the empirical findings, along with verification from simulated market studies (Bishop and Heberlein 1979, 1986; Bishop, Heberlein and Kealy 1983; Heberlein and Bishop 1986) and innovative laboratory experiments (Knetsch and Sinden 1984; Gregory 1986), strongly suggest that these differences are not methodological artefacts attributable to survey design flaws or the hypothetical nature of CV questions[25], but real divergences (Mitchell and Carson 1989).

Although rationales for why WTA measures tend to be much higher than WTP measures have yet to be thoroughly developed, a number of explanatory hypotheses have been put forth. Prospect theory (Kahneman and Tversky 1979)[26] provides the first hypothesis for this disparity. Unlike utility theory, which emphasizes final asset positions, prospect theory analyzes preferences based on gains or losses from a neutral reference point. According to the theory, the value function is steeper for losses than for gains, implying that a decrease in the quantity of a good away from a status quo position is valued at a higher rate than a corresponding increase. This tendency for humans to subjectively experience losses more forcefully than equal gains is known as loss aversion. The main implication for CV studies from this psychological phenomenon is that[27]

[24] *Hammack and Brown (1974), Sinclair (1976), Banford, Knetsch and Mauser (1979/80), Bishop and Heberlein (1979), Brookshire, Randall and Stoll (1980), Rowe, dArge and Brookshire (1980), Knetsch and Sinden (1984) and Coursey, Hovis and Schulze (1987) give experimental results showing WTA exceeding WTP.*

[25] *Although early speculation also centered on whether the WTP-WTA discrepancy could be explained in terms of income effects alone, such a theory has since been rejected (see Gordon and Knetsch 1979).*

[26] *See also Tversky and Kahneman (1981) and Kahneman and Tversky (1982).*

[27] *Prospect theory has other implications for CV studies. Among them is the psychological influence of decision problem framing on the preferences of respondents. It is posited that changes in expressed preferences, or even preference reversal (see Tversky, Slovic and Kahneman 1990 for a description of this phenomenon), can occur as a result of changes in how questions are framed (Kahneman and Tversky 1979,' 1982; Tversky and Kahneman 1981). Context and framing effects provide a basis to many of the biases that may plague CV studies, and are discussed more fully within the "Contextual Bias" subsection under the "Cognitive Biases" section.*

individuals assuming the perceptual position of resource owners (in a WTA format) will place more worth on a resource that they currently posses than they would if they were buyers about to purchase the same resource (in a WTP format) (Brookshire and Coursey 1987).

The buyer-seller disparity rationale is corroborated by dissonance theory, which posits that individuals are highly resistant to relinquish goods that they already own. It is also supported by the "endowment effect" formulation; it denotes that a good which forms part of an individual's endowment would be more highly valued than a good not held if the former (which is an out-of-pocket cost) is perceived as a direct loss and the money given up to acquire the latter (which is an opportunity cost) is perceived as a forgone gain (Gregory and McDaniels 1987).

Another explanation offers the view that people are motivated to give higher WTA values because they reject the assignment of property rights which the WTA format conveys. Many respondents appear to regard WTA property rights as implausible or illegitimate or both, as indicated by the large number of protest answers (implausibly high bids or outright rejections) [28] *which have been consistently received in CV studies using WTA questions (Mitchell and Carson 1989). However, Bishop and Heberlein (1979) and others have found that manifest rejection of the WTA format is less likely when real cash under simulated market conditions is offered. Nevertheless, it cannot be ruled out that protest bids represent actual registration of moral indignation and that scenarios proposing that highly prized public resources be sold off in market-like transactions may be highly offensive to some people.*

A related premise views the other side of the motivational forces which may underlie responses by concentrating on moral responsibility as opposed to moral indignation; namely, it looks at how the a~signment of WTA property rights forces individuals to respond in ways which reflect the responsibilities they have been allocated.

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[28] *See Edwards and Anderson (1987) for evidence and significance of nonresponse bias.*

Higher WTA values could reflect the seriousness with which respondents assume such ownership roles, believing that it is their moral responsibility to make a decision which is in the interests of the greater public good (Harris and Brown 1992). In the case of decisions involving species protection, the assignment of moral responsibility could extend, in the minds of respondents, to the intrinsic interests of the species under their stewardship. These adopted perceptual perspectives may cause individuals to em on the side of caution, obliging them to invest a heightened worth in a resource to protect such interests. WTP measures, on the other hand, make a far less clear assignment of such obligations. As a result, framing effects caused by implicit property right differences when shifting between the two measures may conrnbute to the WTP-WTA disparity (Boyce et al. forthcoming). Harris and Brown (1992) caution,, however, that respondents often feel discomfort with such responsibilities, and if given a choice will provide a WTP measure instead. Empirical data provided by them suggests that individuals' unwillingness to assume ownership status is particularly evident in CV studies involving environmental quality problems which can be tied to industry or other-s. In such circumstances, respondents often pin the obligations on polluters, believing it is they who should pay to resolve such problems.

These and other interpretive models[29] provide partial explanations for the empirical asymmetry between WTP and WTA. It is highly plausible that all of 'the various behavioral facets explained by each model exists, and that the WTP-WTA disparity can only be accounted for by a combination of these identified factors. In addition, theoretical work by Hanemann (1986) has also added a firmer basis to the assertion that the disparity can occur and yet still be consistent with standard economic theory. He has

[29] *For a full account on this subject, see Hammack and Brown (1974), Gordon and Knetsch (1979), Bishop and Heberlein (1979), Brookshire, Randall and Stoll (1980), Rowe, d'Arge and Brookshire (1980), Schulze, d'Arge and Brookshire (1981), Bishop, Heberlein and Kealy (1983), Knetsch and Sinden (1984), Cummings, Brookshire and Schulze (1986), Gregory (1986), Coursey, Hovis and Schulze (1987), Gregory and McDaniels (1987) or Mitchell and Carson (1989).*

shown that the magnitude of the difference between the two measures is determined not only by income effects but substitution elasticity as well. Substitution elasticity refers to the ease with which other market goods can be substituted for the market good under study while keeping an individual's utility level constant. When carried over to the public sphere, the theory indicates that the fewer the substitutes available for the public good and the larger the income effect the greater the WTA-WTP disparity. This reveals that for more unique public goods (which by definition have low substitution elasticities), the divergence between the two measures can be considerable. Hanemann's theoretical relationships thus suggest that the property right chosen has immense implications for the magnitude and reliability of the valuation response, particularly for unique environmental goods and services which form a part of many wilderness values for instance.

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Although the above explanations provide some intuitive conjecture as to why the disparity persists and why the compensation measure commonly exceeds the payment measure, no systematically derived model exists which can provide clear guidance to help determine which measure is more representative of people's values and in which situations one is superior to the other. Acceptance of a difference between the two welfare measures thus forces CV researchers to make the complicated but influential decision of which to choose. The literature is not clear on this point however, with some analysts favoring one, others favoring the other and many stating that the choice is situational. For example, many CV specialists agree that the WTP format is appropriate in situations where increases in the provisional level of a resource are being assessed (Mitchell and Carson 1989).

However, lesser agreement is generated in the case of whether to use the WTA measure in CV surveys assessing decrements. Although WTA may be an appropriate measure of welfare in evaluations of resource diminishments or deteriorations, there is

growing consensus that reliable measurements of WTA cannot be easily made using a CV survey at this time. The rationale for the increasing lack of confidence in the reliability of WTA measures follows similar lines of logic which run through many of the above models regarding the perspective of the ,seller. "The problem in a contingent valuation market", as Carson (1991, 129/30) explains it, "is creating either a plausible situation in which the implicit agent who will purchase the good is likely to convey the money to the participant who can sell the good so that the seller's rational response is to set the price so high that the good will not be sold or a situation in which the purchaser has no choice but to purchase the good so that the seller's rational response is to ask for the highest ieasible amount and not the minimum WTA." Again, unique goods will tend to show particularly ,high WTA responses because of lack of any substitutes to dilute their values.

Because the two measures elicit very different responses and represent distinct forms of welfare measurement, the predicament facing researchers setting up a hypothetical market involving resource depletions is that they cannot simply replace a WTA measure with a WTP measure in efforts of eliminating WTA overestimations. Mitchell and Carson (1989, 37) emphasize the difficulty of choosing an appropriate measure in the face of such obstacles:

> *The result is that contingent valuation researchers continue to be faced with a dilemma: asking people to accept payment for a degradation in the quantity or quality of a public good simply does not work in a CV sqrvey under many conditions, yet substituting a WTP[1] format where theory specifies a lVTA format may grossly bias the findings. This in turn poses a quandary, since researchers frequently wish to value quantities on both sides of the cument level of provision of an amenity, and it is generally agreed that the correct measure for a decrease is the Hicksian compensating surplus WTA measure.*

They goon to recommend the use of the WTP measure for valuing decreases in the level of a large class of public goods that formerly were thought to require a WTA measure, while adding that carefully designed WTA CV studies can be successfully implemented in some limited situations, particularly if a referendum type format is

adopted. Others concur with the notion that WTP measures are the preferred option under most circumstances (e.g., Cummings, Brookshire and Schulze 1986), while others prefer WTA measures for most cases involving resource diminishments (e.g., Knetsch 1984). Many more have adopted positions which lie between these two.[30]

The significance of context in the shaping of preferences underlines the need to resolve differences in professional opinions on this point. The WTP-WTA choice is a powerful example of a contextual influence. Responses will depend to a large degree on the valuation perspective chosen and the manner in which questions are framed. Further study on the different values that people ascribe to gains and losses and how context alters perceptions of such relationships is needed and findings applied to measurement selection and CV design efforts. Until then, professional judgment, proposed hypotheses and preliminary experimental results will need be relied upon to aid in the WTP-WTA selection process.

Design Biases

Design biases are used here to refer to systematic errors arising in WTP responses due to the design features of the CVM questionnaire. These biases relate to how the manner in which the questions are posed or the information is given provide implied cues to respondents which covertly influence the direction of their valuation answers. The main design biases stem from the initiated bid and range, the presented payment vehicle, the sequence or manner in which related goods are presented and, in general, the type of and way in which information is given.

Starting Point Bias

Starting point bias arises when the initial bid introduced in an iterative bidding

[30] *Kahneman (1986, 188), for example, concedes that WTA measures of losses likely generate useless results, but cautions that WTP measures will seriously underestimate the value that people place on many goods in a compensation structure because they do not take into account the reality of loss aversion and, therefore, respondents genuine feelings of loss for resource diminishments or deteriorations.*

framework influences respondents final bids. A number of studies have tested for the existence of starting point bias by, in general, statistically examining the effects of alternative starting bids. While the results have been somewhat mixed and at times inconclusive, more studies have uncovered evidence of its potential presence (Rowe, d'Arge and Brookshire 1980; Boyle, Bishop and Welsh 1985; Mitchell and Carson 1985; Roberts, Thompson and Pawlyk 1985; Cummings, Brookshire and Schulze 1986) than not (Brookshire, Randall and Stoll 1980; Brookshire et al. 1981[31]; Thayer 1981). After reviewing all the evidence, Cummings, Brookshire and Schulze (1986, 207) and Mitchell and Carson (1989, 241) conclude that starting point bias can present difficulties when employing bidding games.

A few explanations have been advanced as to why an initial bid has the potential to influence a respondents final value. One possible source may arise from the suggestiveness of the introduction bid; the bid may convey to the respondent the approximate range of an appropriate final bid, impelling a respondent to anchor his WIT around the suggested final value. Secondly, if the starting bid is significantly different from a respondent's actual WTP and the respondent values his time highly, he may become bored or irritated with a lengthy iterative process and settle on a bid before his true preference is expressed (Schulze, d'Arge and Brookshire 1981; Boyle, Bishop and Welsh 1985; Cummings, Brookshire and Schulze 1986). As a result, starting bids which are well above a subject's true WTP may bias the final bid upwards and starting bids which are well below a subject's true WT.P may bias the final bid downwards; this precise pattern occurred in a study run by Roberts, Thompson and Pawlyk (1985).

The influence of the starting bid is probably accentuated when respondents have poorly defined or developed values regarding a good; respondents, in such cases, tend to

[31] *Mitchell and Carson (1989, 241) reject Brookshire, Randall and Stoll's (1980) and Brookshire et al.'s (1981) conclusions that no starting point bias is evident because the tests "have no power to statistically detect the very large difference they observed." Consequently, they view Thayer's (1981) study as the only convincing test to show its absence.*

be more highly impressionable and agreeable, using the starting bid as an evocative source of information about what their true values should be. The tendency of uncertain respondents to make only modest adjustments away from the starting bid and thus be prone to anchor onto a value which is biased towards the initial value is supported by many in the behavioral science field (e.g., Tversky and Kahneman 1988; Slovic, Fischhoff and Liechtenstein 1988).

The net effect from these contributory sources of starting point bias may be to undermine the Accuracy of the CV survey (Schulze, d'Arge and Brookshire 1981). Moreover, Mitchell and Carson (1989) and Carson (199 1) contend that there is no acceptable way of compensating for the effect of the starting bid in bidding games. They suggest, however, that in general the more plausible and realistic the situation, the easier it will be for respondents to, provide accurate answers.[32] They also recommend the use of payment cards as an alternative elicitation technique. However, as is revealed next, the range of values presented in a payment card format has been implicated in bias as well.

Range Bias

As expressed earlier, the vulnerability of the iterative bidding procedure to starting point bias prompted Mitchell and Carson (198 1) to develop the payment card method. While the range of values on a payment card reduces, if not eliminates, starting point bias, the featured scales may influence the magnitude of a respondent's WTP. Range bias occurs when the respondent believes that the value range on the payment card reflects the true distribution of values, inducing him to use them as a frame of reference to estimate and evaluate his preferences (Mitchell and Carson 1989).

Except for Schwarz et al. (1985), who found a bias of this kind, and Mitchell and

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[32]As Carson (1991, 137) explains, "The uncertainty induced by implausible scenarios promotes bias because the respondents are susceptible to treating supposedly neutral elements of the scenario, such as starting points, as clues to what the value of the amenity should be." Lack of realism and plausibility, therefore, promote many other CV biases as well.

Carson (198 1), who did not, few systematic studies have been done to verify or dismiss the significance of this bias. While empirical evidence is lacking, Mitchell and Carson (1989) identify three potential sources of range bias which could stem from the design configurations of a payment card: (1) the upper most value on the scale may be lower than a respondent's maximum WTP, thus constraining his or her expressed preference; (2) the upper value may impel a respondent to believe that it is a reasonable upper bound, leading him or her to give a higher amount than would have been given had the upper value been Iowev and (3) the range may not encompass the amount that a respondent is willing to pay, inducing the respondent to choose a WTP amount that is either too high or too low. A related behavioral response may be added: a respondent with poorly defined preferences regarding the good in question may perceive the range, particularly if it is evenly spaced, as a normal disrnbution of values and thus be inclined to choose a middle value. Mitchell and Carson (1989) also relate how gaps between numbers, particularly if large, in the area of interest produces bias because people tend to choose either values on the list or values which are multiples of 5's or 10s.

It is not known at this point how significant range bias is. A properly designed payment card which takes into account these various facets of behavioral influences may reduce the incidence and severity of such problems. For example, sources of the first kind may be avoided by setting a sufficiently large upper bound (although this may stimulate influences of the second form). However, before widespread adoption of the payment card method occurs, further research should be done to assess its accuracy and the means of refining or reconfiguring its design characteristics to improve its accuracy.

Payment Vehicle Bias

This form of bias occurs when the method of payment specified in a survey 'generates a reaction in a respondent which translates into a distorted response. For example, individuals generally have an aversion to taxes; subjects might as a result

understate their WTP for a good if its mode of financing is to be made through increased taxes. On the other hand, an entrance fee, if the non-market good is recreation, may produce a less strident reaction (Cummings, Brookshire and Schulze 1986; Gunton 1991).

Besides emotional reactions to payment methods potentially biasing results, familiarity with payment methods may also bias results. An example of this would be when hunters use the prevailing price of hunting permits, with which they are familiar, as a benchmark for their WTP calculations in a survey employing hunting Iicence fees as the payment vehicle. Consequently, instead of expressing a maximum WTP amount which resembles their preferences they may express a WTP amount which they regard as a reasonable price to pay for permits of this nature. [33] *The payment schedule may also influence the magnitude of the WTP answer. People may, for example, be more comfortable (i.e., the payments may seem less onerous) making a series of payments (say, $/annum over next 5 years) rather than a lump sum payment, thereby arriving at a larger cumulative WTP for the former.*

Numerous researchers have compared elicitation results from alternative payment methods to detect for the presence of vehicle bias (Brookshire, Ives and Schulze 1977; Rowe, d'Arge and Brookshire 1980; Brookshire et al. 1981; Daubert and Young 1981; Greenley, Walsh and Young 1981). Except for Brookshire et al. (1981), whose results were inconclusive, all of the studies listed here empirically confirm that payment methods influence valuation. Moreover, the literature largely supports the vehicle bias proposition

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[33] *Mitchell and Carson (1989, 198) offer this line of reasoning as a possible explanation for Bishop and Heberlein's (1979) low WTP results for goose hunting permits. Other rationales are also forwarded (e.g., strategic bias). Such an effect also occurred in a study conducted by Sorg and Brookshire (1984) using an open-ended format to value the elk resource; half the respondents in this study gave the current cost of an elk hunting licence. Though this may be counter-intuitive to the notion that a presented scenario should be as realistic and familiar as possible to avoid biases, Mitchell and Carson (1989, 216) note that scenarios such as these can induce biases because they involve quasi-private goods which have prevailing prices to which respondents' are tempted to anchor WTP values. They also state that it may be compounded by providing too much information; in such situations, respondents may react to the information overload by ignoring important information and focussing excessive attention on less relevant, albeit familiar and persuasive, information. However, in general the position forwarded in footnote 32 holds.*

(Randall, Ives and Eastman 1974; Schulze, d'Arge and Brookshire 1981; Rowe and Chestnut 1983; Cummings, Brookshire and Schulze 1986).

The literature, however, provides little in the way of guidance in how to minimize or eliminate it. Alternatively, Arrow (1986) and Kahneman (1986) point out that efforts at designing an unbiased payment vehicle are largely wasted because the method of payment forms an integral part of the evaluation; in other words, the evaluated commodity and the payment procedure cannot be separated. Hence, they maintain the assertion that there is nothing irrational about individuals responding differently to different payment vehicles; in fact, it is completely rational to have a different set of preferences for taxes than for user fees than for utility bills. Arrow (1986) concludes that WTP depends on the structure of the means of payment and that such a relationship is reasonable in most cases.[34] *Based upon the strength of such arguments, Cummings, Brookshire and Schulze (1986) concur that the impact of the means of payment on the respondent's elicited value is not a problem. They add, in agreement with Mitchell and Carson's (1989) and Carson's (1990) emphasis on the need to build into scenarios realism and plausibility, that the mode of payment should be selected on the basis of what payment vehicle would realistically be employed were the non-market good provided.*

Relational Biases

Relational biases are used here to signify a class of biases which spring from the linkages between the evaluated good and other related' or' interrelated goods. These biases are said to occur only when such relationships influence a respondent's formulation of his or her WTP in a way unintended by the researcher. A related good can give off distortion-engendering cues by acting as a comparative benchmark, by functioning as a neighboring good within a sequence of goods and by serving as a larger good within which

[34] *However, he adds the following caveat (p. 183): "Now for others, it may not be. YOU can get the framing problem. Say you get two methods of payment where every individual in fact is paying the same amount, or at least his or her random expected payment is about the same. Then if the responses differ, you may have a real vehicle bias."*

the evaluated good is embedded.

Benchmarks

Relational bias can occur when benchmark amounts listed on payment cards inadvertently prejudice respondents opinions on the good(s) being evaluated. As Mitchell and Carson (1989) point out, the benchmark values of the reference goods are supplied with the intention of informing respondents about the existence and magnitude of taxes which they are already paying for many public goods and prices which they are paying for regulated goods. However, impressionable subjects may rely on such prices to infer their WTP rather than constructing them from their own preferences. Mitchell and Carson (1981, 1984) tested for this kind of relational bias in their national water quality studies by systematically varying the dollar levels for the non-environmental benchmarks (e.g., police, fme protection, roads, highways, etc.) and the number of benchmarks on the payment card. They found no undue influence from these benchmark factors on respondents' WTP results in their study, but concede that potential still exists in other situations.

Because of the threat of benchmark-based relational bias, Mitchell and Carson (1989) recommend that reference goods be chosen which are not directly related to the non-market good being valued. Also, to avoid inciting WTP responses which are framed only within the context of controversial items rather than within the larger framework which includes all items on the card, they warn that benchmarks should not be controversial or evocative. With few studies having tested for it, it cannot be said how significant bias from benchmarks are.

Sequencing

The sequential evaluation of decision alternatives has been found to produce different preference expressions than simultaneous evaluations (Tversky 1969). Also, the position of an item in a sequence of valuation questions has been found to generate

variable responses, with a higher WTP value commonly occurring for an item if it is fnst in the list rather than following others (Plott and Levine 1978). Tolley and Randall (1983), for example, found that the value of improved visibility in the Grand Canyon differed by a factor of three depending on whether this item appeared before or after questions dealing with air quality in the respondent's own city. Brookshire et al. (1981) also found a sequencing effect in their study on people's valuations of air quality-induced aesthetic and health effects. Although the severity of sequence' bias is unknown at this time, its significance should not be understated. Kahneman and Knetsch (1992, 58) add that "Because the order in which goods are mentioned in a survey is purely arbitrary, any effect of this variable raises questions about the validity of responses."

Embedding

The embedding effect, which has been raised as a possible bias in the CVM by Kahneman and Knetsch (1992), refers to the difference between the value of a good when assessed on its own and the value of the same good when assessed in conjunction with other related goods. They found, as reported in Kahneman (1986), that Toronto residents' WTP was only slightly higher to prevent fish population losses in the entire province of Ontario than their WTP to preserve fish stocks in only a small area of the province. Based upon the results from this study, and others reported in Kahneman and Knetsch (1992), they conclude that the value of a good when inferred from the WTP for an inclusive good in which it is, a component part will tend to be less than if it is evaluated on its own. They also conclude that although the effect is probably more pronounced when eliciting non-use values, use values are not immune to its influence.

They attribute the embedding effect to the fact that respondents perceive non-market goods in broader terms than previously ascribed; that is, they are viewed in terms of the sense of moral satisfaction that people receive when contributing to the provision of such goods, rather than the goods per se. Claiming that such a general hypothesis is

consistent with economic analyses of altruistic behavior, Kahneman and Knetsch assert that moral satisfaction stemming from contributions to an inclusive cause can also be given to a subset of that cause with little loss in value. They add that all public goods conceptually far removed from the buying and selling functions of markets, whether they have use or non-use value, are susceptible to this effect because purchases contributing to such amenities as park expansions or species preservation have more in common with charity than with the purchase of consumption goods. As a result, the WTP value, like the WTA measure, may also be,registering another form of moral concern (namely moral satisfaction), making inadequate the interpretation that WTP for the protection of public goods is equivalent to consumption good purchases.

While conceding that embedding effects are not likely to be an ubiquitous presence in all CV studies, Kahneman and Knetsch (1992) point out that when it does occur it is 'not clear which measure (aggregate or disaggregate?) is the appropriate one. Principles that could guide the choice of embedding level are lacking in the literature, and they question researchers' abilities in finding one. Because the embedding level is arbitrarily chosen and because there is the possibility that peoples' true WTP measures are further concealed by their purchase of moral satisfaction, Kahneman and Knetsch conclude that the CVM is a very inaccurate technique for estimating economic values.

Gregory, Liechtenstein and Slovic (forthcoming), while supporting its plausible presence, propose that the embedding effect's fundamental cause does not stem from expressed preferences not matching those being sought by CV analysts due to the implicit addition of unintended assumptive details (i.e., moral satisfaction gained from contributions) on the part of respondents. Instead, it is a measurement failure stemming from respondents' lack of clearly-defined monetary representations of many non-market values, particularly in unfamiliar contexts. This clearly fits in with Kahneman and Knetsch's view that the factor that controls the severity of the embedding effect is the degree to which a good can be conceived of in purchasing terms. Another possible

explanatory cause of embedding linked to measurement failure is the insensitivity of many participants to the precise meanings of the questions asked, possibly because relevant details are excluded (contributing to uninformed judgments), possibly because too many details are included (contributing to cognitive overload) (Fischhoff et al. 1993).

Mitchell and Carson (1989) also looked at the notion of aggregation problems by reviewing the literature for the significance of "symbolic bias" and "part-whole bias''.[35] *Based upon their examinations, they came to the conclusion that such problems can bias results. However, they are more hopeful than Kahneman and Knetsch that such biases can be minimized through disaggregation strategies involving improved wording and clearer descriptions of the goods under evaluation. Fischhoff et al. (1993, 230), whose study found that a cognitively simpler paired comparison approach generated less of an embedding problem than a more demanding experimental design based on direct dollar estimates, support Mitchell and Carson's emphasis on the need for clarity to offset such effects when they state that there is a "need to ensure that subjects have heard, interpreted, and accepted a task's details as intended." They go on to stress, in reference to the level of detail to include and complexity of task to accept, the proba~le importance of infusing scenarios with realism and structural coherency: "One determining factor may be whether the full task creates a coherent whole, whose features can be ~hunked into smaller sensible units. That seems more likely when the CV scenario is derived from an actual problem rather than being composed of arbitrary details, patched around a focal good."*

Although debate is still mixed and conclusions are premature on the question of the embedding effect, it has raised serious concerns about the ability of the CVM to

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[35] *Symbolic bias occurs when respondents base their valuations on the general symbolic meaning of the amenity and not its specific level of provision. Part-whole bias, on the other hand, occurs when respondents are unable to differentiate between an amenity's provisional level and a larger geographic area, a larger aggregation of entities, a larger policy framework, etc. in which it is embedded (see Mitchell and Carson 1989, 249-52).*

uncover people's true preferences. Whether it be charitable inclinations, tenuous monetary representations, insensitivity to questions framed or elements of all three which are at the root of this bias, the commonality between them, namely that people's representations of non-market values are often poorly-defined and difficult to retrieve, seriously undermines confidence in the CVM, as traditionally designed. Mitchell and Carson's (1989) and Fischhoff et al.'s (1993) suggestions may point the way towards refinements in the CV design. However, some of the more conceptually elusive and indivisible values of wilderness, such as non-use, aesthetic, cultural and ecological, may be far more intricate and entangled than even the most ingeniously designed contextual frames devised within a CV study could handle.

The notion that values are multidimensional and that people thus cognitively define values in more complicated terms than can be captured by a unidimensional expression of value is being advanced by Gregory and McDaniels (1987) and Gregory, MacGregor and Liechtenstein (1992). As such, the true worth of these wilderness values could remain hidden, and the representative value of WTP could be orders of magnitude different. Closer monitoring of the significance and greater debate over the causes of embedding, as well as other effects related to the aggregation and multidimensionality of values, may shed more light on these recent challenges.

Information Bias

Information bias has been generally regarded in the literature in excessively broad terms. Rowe, d'Arge and Brookshire (1980, 6), for example, define it as "a potential set of biases induced by the test instrument, interviewee, or process, and their effects on the individual's responses. " By including many sub-categories of biases (many of which have already been described), such a conception fails to be specific enough to provide guiding principles for research efforts looking into its significance. Mitchell and Carson (1989) also point out that, like the payment vehicle, information contained in a survey is a

legitimate and inexrncable part of the valuation exercise. Rational subjects should, therefore, vary their responses according to differences in the information provided.

However, because the information provided has the potential to alter people's reported WTP values, genuine concerns are being raised over such issues as which information to disclose, how to disclose it and in what order it should be disclosed (Schulze, dArge and Brookshire 198 1; Rowe and Chestnut 1983). If facets of information disclosure such as these produce varied valuations [36] when changed, the fundamental questicm is what value is closest to the respondents true preferences? It is of course impossible to answer this question because as we discovered earlier with validity issues, no understood abstract value exists to compare WTP values to. Also, because the detail, characteristics and quality of the information provided vary for each situation in a random rather than systematic way, "information bias" is a misnomer in that it affects the reliability rather than the validity of the contingent values.

Nevertheless, this problem parallels the previous biases in that it belongs to the larger issue of changing contexts, and their influences on preferences. Gregory, Liechtenstein and SIovic (forthcoming), after studying the research looking into the nature of human preferences, conclude, for example, "that people are not just reporting their values or preferences. Instead, they are constructing them, with whatever help or cues the circumstances provide." This constructiveness view of human values implies that the quantity and quality of information provided may not only influence the magnitude of a person's WTP but his or her underlying preferences as well. If true, such a notion has significant design implications for the CVM as well as other expressed preference elicitation methods. As Gregory, Liechtenstein and Slovic (forthcoming) point out, "...value formation is intimately tied to the specifics of the elicitation procedure."[37]

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[36] *Little in the way of strong empirical data exists to support the information bias proposition. For example, of the studies conducted by Rowe, d'Arge and Brookshire (1980), Brookshire et al. (1981), Thayer (1981) and Samples, Dixon and Gowan (1986) only Rowe et al. discovered evidence of it.*

[37] *They propose as a solution to the inadequacies inherent in the holistic design of the*

Motivational Biases

Gregory (1982, 55) defines motivational biases as "intentionally introduced distortions of what the respondents feels are his or her true preferences." Misrepresented responses more often than not result from incentives or disincentives which are built into the interview situation in some way. It must be kept in mind, however, that although motivational biases have been raised as a set of possible problems and probably represent true distortions in some situations, a paucity of tests have been done on them; they thus by and large represent the intuitions of CV theorists. Three major classes of motivational biases are described here: interaction, strategic and hypothetical.

. Interaction Bias

This form of motivational bias is rooted in the dynamics of the interaction between the interviewer and respondent. Personality conflicts are examples of where such a bias can originate. For example, an arrogant, boring or discourteous interviewer may frustrate, tire or anger a respondent, inciting the respondent to retaliate by purposefully misstating his or her preferences or by making extreme judgments (Gregory 1982).

Oppositely, respondents may engage in a form of compliance bias (Mitchell and Carson 1989) by attempting to give answers which please the interviewer or sponsor. Distorted responses of this kind may be particularly embellished when the respondent believes the interviewer represents a particular position on an issue (Gregory 1982), the respondent is not abreast of the issues raised in the interview (Schuman and Presser 198 1) and/or the interviewer implicitly or explicitly sends out signals which, whether intentional or not, sways the respondent's answers in a particular direction (Gregory 1982).

Evidence is mounting in the psychological literature that people are easily influenced by others and accept other, more influential persons' attitudes often without

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CVM a hybrid approach, which integrates the CVM with the multiattribute utility technique.

critical analysis (Harris, Driver and McLaughlin 1989). Research indicates that people easily accept presuppositions as facts (Loftus, Miller and Bums 1978), confuse inferences with direct observations (Harris and Monaco 1978) and put greater degrees of belief into statements if they are repeated again and again (Hasher, Goldstein and Toppino 1977). Harris, Driver and McLaughlin (1989, 221), after reviewing such evidence, state: "Consequently, the normative signals given the respondent by interviewers or questionnaires applying the CVM may be particularly problematic, given the novel and potentially complex judgment problem that this method poses."

Strategic Bias

Strategic bias occurs when respondents deliberately provide misleading answers in their attempts of influencing the study's outcome in a way which serves their own interests. It is proposed that the hypothetical structure of the CV setting may provide motivational incentives to act strategically, with the strategic posture assumed varying according to how the respondent perceives the structure of the contingent market. For example, if a respondent who desires a river to be cleaned up believes that he or she will be personally responsible for paying an amount in taxes dedicated to cleanup which is equivalent to his or her specified WTP amount, an incentive exists for the subject to free ride and understate his or her own true values, hoping that others will bid enough to have the program implemented.

Alternatively, if the average of all WTP amounts is taken as the tax level which all respondents must pay to produce a desired outcome, two major strategic postures could be taken. First, incentive to understate a true preference exists if a respondent believes that the average WTP level of all others is above his or her actual WTP. Second, if a respondent believes that implementation of the desired policy will not occur without a sufficient WTP amount given by him or her, incentive exists for the subject to provide a bid which is high enough to permit implementation but low enough to prevent the average

WTP from slipping above the subject's actual WTP. Another example of a free-rider problem is when a respondent living in a specific region suspects that other nearby residents will bear control costs to clean up an airshed polluted by a power plant; a respondent who desires air quality improvements would have an incentive in such a situation to overstate his or her maximum WTP (Schulze, d'Arge and Brookshire 1981; Hufschmidt et al. 1983; Randall, Hoehn and Brookshire 1983; Rowe and Chestnut 1983; Anderson and Bishop 1986).

The extent of strategic bias depends on a number of factors. First, respondents must suspect that the study results will have an effect on program or policy implementation. In other words, no strategic incentive exists if respondents believe or know that the survey results will not influence a policy or an outcome (Schulze, dArge and Brookshire 1981). Second, respondents must believe that their responses will produce, or at least not hinder, a desired collective outcome while not being detrimental to their own personal cause. Third, they must be willing to be dishonest and understand their preferences sufficiently to provide a strategically dishonest answer (Gregory 1982). However, most hypothetical market scenarios are devised to elicit information which in most cases is not directly applied to policies or programs. Respondents often suspect this, thereby undermining the first assumption. Moreover, respondents normally have a very poor conception of the hypothetical mean and in general lack sufficient information to act strategically, contravening the second assumption (Schulze, d'Arge and Brookshire 1981; Randall, Hoehn and Brookshire 1983). Also, as we have seen, even if respondents are willing to provide dishonest answers, poorly developed values will make tenuous the third assumption.

Much of the empirical evidence supports the notion that there is little scope for strategic behavior and in general has found little influence from strategic bias.[38]

[38]*Bohm (1972), Scherr and Babb (1975) and Smith (1977) are examples of studies which found no evidence of strategic bias. After reviewing these and other studies Mitchell and Carson (1989, 170) observe that although not conclusive, "the evidence.. suggests that*

However, although the evidence is encouraging it is not definitive. Because such studies can neither confm or deny its universal presence, strategic behavior cannot be ruled out in every situation. For example, individuals may partake in strategic bias in polarized decision environments if they believe the results, if not affecting public policy, will at least have an influence on public opinion. In situations related to harvesting-wilderness tradeoff decisions, for example, forest industry personnel will have incentives to understate their wilderness valuations while environmentalists will tend to overstate theirs (Gunton 199 1). So, while strategic bias is probably the exception rather than the rule, absence of a basis for categorical denial of the problem may lead some researchers to the recognition that they should at least consider it when designing and applying CV surveys in decision environments which encourage misleading answers.[39] *However, Mitchell and Carson (1989, 170) point out that "The potential threat posed by respondents deliberately giving untruthful WTP values is likely to be much less serious than the' possibility that they will give meaningless values."*

Hypothetical Bias

Even if incentives to manipulate responses strategically are minimal, the hypothetical nature of CV markets may provide disincentives to answer accurately. Hypothetical bias has been proposed as a validity problem which stems from the artificiality of the CV framework and the manner in which people speculate on their behavior in hypothetical market situations. It has been widely suggested that because people do not invest the same level of contemplation, research, time and care in arriving at a WTP amount as they would were they pricing and purchasing items in an actual market,

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strategic bias is not a significant problem for CV studies under most conditions. Instead of being a fundamental, unavoidable threat to the CV method, strategic behavior is just one of many possible sources of bias which the designer of a CV study must take into account. " Schulze, d'Arge and Brookshire (1981) and Cummings, Brookshire and Schulze (1986) also reviewed the findings and came to similar conclusions.

[39] *See Mitchell and Carson (1989, 162-5) for conditions that promote strategic behavior in CV studies.*

they lack the same incentives required to give accurate responses (Bishop and Heberlein 1979; Freeman 1979a; Bishop, Heberlein and Kealy 1983; Rowe and Chestnut 1983). In other words, contingent values, which are measures of behavioral intentions or attitudes, may differ significantly from market values, which are measures of buying and selling behavior, because the former is more speculative and labile than the latter (Heberlein and Bishop 1986). The dissimilarity between behavior in actual and hypothetical market settings and the implications from such a disparity are illustrated by Bishop, Heberlein and Kealy (1983, 627) in the following manner

> *Prior to being confronted by an interviewer or mail survey, subjects may never before have attempted to express how they feel about environmental assets in monetary terms. While constrained utility maximization is a useful construct, conversion of utility into monetary terms in the real world may involve repeated market transactions over time, consultation within peer groups, assessment of the markets for complements and substitutes, consultations within the household, and references to consumer information. It is questionable whether the interviewer or questionnaire designer can fully compensate for the lack of such experience and information in the limited time and space available. Hence, subjects are forced to deal with a situation which seems quite artificial from their point of view in comparison to situations where they normally arrive at monetary values. While the researcher hopes they will follow the same mental processes they would use in real markets, the social context within which contingent valuation occurs may be so artificial that people will be unwilling or unable to do so.*

However, Mitchell and Carson (1989) caution that such criticisms fail to distinguish between the systematic errors which underlie problems of validity and bias and the random errors which underlie reliability issues. They contend that hypotheticality is associated with random rather than systematic error. Lack of realism within a scenario therefore promotes random, directionless error not bias (Thayer 1981, 32). The failure of CV researchers to. "translate posited sources for hypothetical bias into testable hypotheses and to test them..." (Cummings, Brookshire and Schulze 1986, 17) supports the proposition that the artificiality of the CV environment promotes reliability problems rather than validity problems.

Nevertheless, although the severity of hypotheticality cannot be systematically

determined, the problem can be significant and does form a structural basis to the biases and problems outlined earlier. For example, the embedding effect is either fundamentally caused (Gregory, Liechtenstein and Slovic forthcoming) or aggravated by (Kahneman and Knetsch 1992) a persons poor representation of contingent values, with monetary judgments being particularly occluded in hypothetical scenarios which are far removed from real market situations. Lack of realism probably also aggravates peoples' susceptibility to starting point and range biases (Boyle, Bishop and Welsh 1985). The WTP-WTA disparity may also result in part from the hypothetical nature of the questions asked (Bishop and Heberlein 1979; Rowe and Chestnut 1983).

This suggests that sources of error such as these can be minimized by increasing the realism, understandability, plausibility and meaningfulness of the scenario, as well as the perceived significance of each respondent's answers (Cummings, Brookshire and Schulze 1986; Mitchell and Carson 1989). There is a question, however, regarding how much realism can be reasonably injected into a CV exercise in order to diminish the divergence between the contingent market and a real one. For examde, the most implausible and unreal hypothetical markets are often associated with those values which are poorly understood and monetarily represented, as is the case with many of the more elusive wilderness values. Also, adding realism may itself introduce bias. This conundrum is represented by Mitchell and Carson (1989, 216) in the following way: "The researcher who wishes to make a scenario more realistic faces a tricky problem: on the one hand, an insufficiently realistic scenario will be vulnerable to bias; on the other, the elements which add realism to a scenario may themselves cause bias. " Thus, additional information can add realism when discerningly given, but can also add bias-inducing cues to vulnerable respondents when imprudently given.

"Information overload", whereby respondents neglect important information and concentrate instead on unimportant information when forming their WTP answers, may

also result when attempting to construct a realistic contingent market (Mitchell and Carson 1989, 216). Again, monetarily obscure and poorly perceived goods will require particularly high investments of information to make the market context and WTP questions realistic, provoking possible biases in the process. This issues back to the influences of context and question framing on elicited values. Such tensions will need to be accounted for when designing a survey which includes material which is intended to convey a credible market but which may unwittingly affect WTP responses. [40]

Cognitive Biases

The preceding sections revealed that potentially serious biases and random errors can occur out of subtle design features and elicitation stimuli. It also uncovered that explanations for the causes of these distortions more often than not broadly focus on the relationship between the contextual setting framed within a CV study and the manner in which humans process information, and how changes in the former influence the latter. The adoption of the psychological perspective was particularly pronounced when hypothesizing on how respondents react to agglomerated public goods and property rights for public goods. Psychological studies looking into how humans process information has received increasing attention from many CV theorists in recent years as they have begun to discern the overriding significance of the perceptual dimensions of contingent valuations and the relational tensions between attitudinal intentions and CV framing effects. Such attention has also highlighted the possible significance of cognitive biases.

Cognitive biases are defined by Gregory (1982, 62) as "unintentional distortions of true preferences which result from limitations in an individual's ability to perceive, process, and evaIuate uncertain or unfamiliar information." He goes on to say that they tend to be pervasive, resistant to change and systematic. They also tend to be most influential and extensive in studies involving complex and intellectually-challenging

[40] *See Mitchell and Carson (1989, 217-19) for suggestions on how to reduce random errors while minimizing biases.*

evaluation tasks, such as the case when evaluating environmental amenities and activities, "since both the identification and valuation of preferences will in most cases involve references to uncertain conditions or events, the assessment of information of limited validity and the weighing of competing or incommensurate factors" (pp. 62-3).

The limits of human cognition and the corresponding dissonance between true preferences and expressed preferences highlight the significance of cognitive biases, particularly when respondents are required to process unfamiliar and uncertain, and thus cognitively-demanding, information. A number of prominent cognitive biases are identified by Gregory (1982), including anchoring bias, overconfidence bias and contextual bias.

Anchoring Bias

An explanatory model for starting point bias centered on the' tendency of individuals to be influenced by the initial bid when adjusting their expressed values away from the starting point. Anchoring bias occurs because people are prone to use the starting point as a frost approximation or anchor for their judgments. Because subsequent adjustments, and the perceptions and valuations they represent, are still strongly influenced by the impressions received from the starting point value, total movement away from the starting point tends to be smaller than it should be considering the importance of new information (Tversky and Kahneman 1981; Slovic, Fischhoff and Liechtenstein 1988). The unintentional nature of the cognitive tendency to be highly impacted by frost impressions implies that despite respondents' sincere efforts of not succumbing to the influence of a starting point or initial assumption, they are less insightful and adaptive than is needed in most cases (Gregory 1982).

Overconfidence Bias

Gregory (1982) outlines four sources which boost respondents' confidence to the point where they overestimate their abilities to perceive and evaluate information, thereby biasing their valuations. Firstly, when evaluating unfamiliar or labile values, respondents may be more compelled to respond to an interviewer's question rapidly rather than admit

their ignorance of the subject or their poorly-defined attitude. This bias tends to be carried through the evaluation even if commitment to an initial invalid position involves suppressing other inconsistent or competing views. A second related source stems from respondents' denial of uncertain outcomes, causing such outcomes to be viewed as known or safe entities, thereby skewing the value of their expressed preferences. Another source results from the tendency of respondents to underweigh outcomes which are probable in comparison to those which are more certain. Lastly, respondents may engage in a form of hindsight bias by believing, without realizing it, that they knew that a particular event would occur, even though they were just told about it for the first time within the valuation study (Fischhoff 1975, 1982). This last source can promote overconfidence bias by instilling within respondents forecasting and predictive abilities they do not have.

Contextual Bias

Context was alluded to earlier as an underlying factor which shapes peoples' impressions and assessments of particular non-market goods and services. Hence, the differing perspectives surrounding WTA and WTP measures of consumer surplus, the relational aspects of sequencing and embedding, the type and quantity of information provided, the hypothetical scenario presented, the elicitation method used, and so on all have contextual dimensions which when altered can have significant effects on people's expressed preferences. For example, information overload (Mitchell and Carson 1989) and inclusion of irrelevant information (Gaeth and Shanteau 1984) seem to impair judgment. Slovic and McPhillamy (1974) showed that an otherwise minor attribute is assessed more highly than normal if it is described more clearly and completely than other atrnbutes.

Moreover, with Prospect Theory revealing that losses are more highly valued than gains, expressed preferences and choice decisions can be significantly impacted by whether an outcome is framed as a gain or a loss and whether a negative outcome is

evaluated as a cost or an uncompensated loss. For example, Tversky and Kahneman (1981) demonstrated that people can reverse their preferences if the wording of two public health problems was framed in terms of "saving lives" versus "loss of life". Context effects such as these suggest that question wording and other "framing effects" (Tversky and Kahneman 1981; Hogarth 1982; Slovic, Fischhoff and Liechtenstein 1988) which build and shape the character of context can significantly affect the estimation of preferences. As a result, Fischhoff, Slovic and Liechtenstein (1980, 118) make the argument that "Subtle aspects of how problems are posed, questions are phrased, and responses are elicited can have substantial impact on judgments that supposedly express people's true values."

It appears that people when faced with complex values unconsciously utilize simplifying strategies to cognitively organize alternatives (Harris, Driver and McLaughlin 1989; Payne, Bettman and Johnson 1992), with such strategies being relied on more heavily as the complexity of the valuation task increases (Johnson, Meyer and Ghose 1989). This is often accomplished by, among other things, disregarding shared traits and integrating similar characteristics between alternative goods (Gregory 1982), relying on easily imaginable information or, as we have seen, anchoring on starting points (Gregory, Liechtenstein and Slovic forthcoming). Such judgmental rules of thumb, or heuristics, while being useful and at times necessary to simplify complex judgments, can produce biases (Kahneman, Slovic and Tversky 1982).

Because CV studitx typically require respondents to make holistic judgments about multidimensional values, they provoke respondents to take short-cuts and make use of fewer cues to construct their representations of expressed preferences than they would in cases of more detailed sets of tradeoffs (Slovic and Liechtenstein 1971; Harris, Driver and McLaughlin 1989). Holistic CV studies are thus vulnerable to promoting contextual bias, as people pick up on and incorporate into their valuations emphasized,

cognitively simpler, better known, easily monetized, and/or other cues which simplify the task of preference development; at the same time, respondents tend to ignore many cues or information which may be important for an accurate portrayal of preferences, but which lay hidden or are obscure and thus complicate the mental effort involved in constructing a unitary measure of such preferences (Kahneman and Tversky 1979; Slovic, Fischhoff and Liechtenstein 1988; Tversky and Kahneman 1982, 1988).

Based upon these and other findings and hypotheses arising from behavioral research, critics of the CVM assert that a unitary measure cannot capture with any accuracy the value of a good which is made up of complicated combinations of known, unknown and poorly conceived parts (Gregory, Liechtenstein and Slovic forthcoming). Instead, procedures which decompose wholes into their constituent parts are often recommended above holistic approaches for multidimensional values because they allow respondents to actively construct their values from the bottom up. One set of decomposition procedures which has received particular attention in recent years is multiattribute utility technology, a topic to which we now turn our attention.

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3.2 Multiattribute Utility Technology Procedure

Multiattribute utility technology (MAUT)[41] *represents numerous models and techniques which provide "a formal basis for describing or prescribing choices between alternatives whose consequences are characterized by multiple value relevant atrnbutes" (Fischer 1975, 7). It was originally conceived as a means of quantifying and analyzing complex individual ~references among decision alternatives that vary on multiple conflicting objectives (Edwards and von Winterfeldt 1987). Several MAU elicitation techniques have been designed to measure values of objects or outcomes which have several dimensions or attributes of value. In the same manner that the TCM, H.PM and*

[41]*See Fischer (1975), von Winterfeldt and Fischer (1975), Edwards (1977), Johnson and Huber (1977) and Edwards and Newman (1982) for procedural overviews, assessments and applications of MAUT.*

CVM preapplications of theunderlying conceptual assumptions of benefit-cost analysis, MAUT is linked to the assumptions of decision analysis (DA).[42] *As such, many prescriptive MAU models and sets of assessment procedures have been developed to assist decision makers in their quest in forging more informed tradeoff decisions. Although it can be used as a descriptive tool to explain and predict the tradeoffs of decision makers who are left on their own (Fischer 1975), the techniques and models of MAUT are best applied in a normative manner to guide decisions (Kozielecki 1981; Edwards and Newman 1982).*

While numerous MAUT procedures exist in theory and practice, von Winterfeldt and Edwards (1986, 273) identify five steps which they all include:

1. *Define alternatives and value-relevant attributes.*
2. *Evaluate each alternative separately on each attribute.*
3. *Assign relative weights to the attributes.*
4. *Aggregate the weights of attributes and the single-attribute evaluations of alternatives to obtain an overall evaluation of alternatives.*
5. *Perform sensitivity analyses and make recommendations.*

They point out that steps 1 and 5 are similar for all MAUT techniques, while procedures for single-attribute evaluations (step 2), assigning weights (step 3) and modelling for aggregation (step 4) differ between them. The presented steps reveal that MAUT methodologies provide a means of decomposing the overall multifaceted evaluation task into a set of simpler subtasks, easing the judgmental burden of the decisionmaker (Eils and John 1980). Being based on the "decomposition paradigm" (Kozielecki 1981), MAUT facilitates the construction of single-attibute value and utility functions, which, after being recomposed using a suitable aggregation rule and weighting

[42] *Decision analysis is a normative framework and set of systematic procedures and methods developed to rationally analyze complex and uncertain decision problems and provide guidance to decision makers. For comprehensive reviews see Raiffa (1968), Keeney and Raiffa (1976) and von Winterfeldt and Edwards (1986). Keeney (1982) provides a good procedural overview of DA, while Howard (1980, 1988) are good sources for assessments of DA.*

scheme, provide utility measures of respondent's expressed preferences for the various multidimensional alternatives under evaluation.

To illustrate its use, a simplified version called SMART (simple multiattribute rating technique; see Edwards 1977; von Winterfeldt and Edwards 1986) will be briefly outlined as an example of MAUT. Edwards' SMART consists of ten steps, which Hogarth (1980, 228) has subdivided into the following four phases: (1) structuring the problem; (2) determining the importance of the dimensions of value; (3) measuring alternatives on the dimensions; and (4) choosing the optimal alternative. Although numerous aggregation rules and weighting procedures have been developed for MAUT, the methods illustrated here concentrate on taking a weighted linear average. Besides being more widely used, understandable and simpler than other methods, there is empirical and theoretical support in the literature (Dawes and Corrigan 1974; Einhorn and Hogarth 1975) to suggest that the linear model presented yields close approximations to much more complicated nonlinear and interactive utility functions (Edwards 1977).

Structuring the Problem

The MAUT process begins with the structuring of the decision problem. This phase identifies the stakeholders, the decision problem or purpose of the evaluation, the entities to be evaluated and the dimensions or attributes of value. Because an initially clear structure provides improved guidance for respondents and interviewers alike throughout all the remaining phases and because the best alternative may become evident simply by structuring the problem, the structuring exercise is considered by many as the most important MAUT phase (Edwards 1977; Hogarth 1980; von Winterfeldt and Edwards 1986). As McDaniels (1990, 14) puts it, "If decision making processes founder it is often because of a lack of a clear structure."

Step 1: Identify the Stakeholders to be involved

The structuring phase begins with the determination of all relevant individuals or interest groups who have a stake in the decision and who should be included in the

process. Stakeholders provide the value attributes which aretobe elicited. Attributes are the value dimensions which stakeholders care enough about that to ignore them in the decision framework would lead to a poorer decision than if they were considered (Edwards and Newman 1982).

Step 2: Identify the Decision to be Made

Detemining thedecision to be made brings into focus the purpose and context of the value elicitation exercise. Along with the identified stakeholders, the context and purpose of the decision shapes the utility values to be elicited (Edwards 1977; Hogarth 1980). The decision context is defined by Keeney (1992, 30) as that which "defines the set of alternatives appropriate to consider for a specific decision situation." The purpose of the decision, on the other hand, represents the fundamental reasons for requiring clarification of the issues represented in the decision. It is thus extremely important to clearly define and identify the decision context and purpose from the onset.

An example of a decision component which needs to be carefully considered is the relationships and implications arising from different but related decisions. Because decisions can be regarded at different hierarchical levels, from the higher order, fundamental goals to the lower order, contributory goals, the decision identification step should define the decision level which is relevant for the values being elicited. Determining the hierarchy of decisions in which the evaluated decision is nested is also important because higher order issues provide insight into lower order issues. McDaniels (1990) exemplifies hierarchical identification within the context of the forest preservation issue in B.C. and the U.S. Pacific northwest: Various organizational processes designed to tackle different facets of the issue have broadened their frame of reference by shifting their focus away from lower order questions (e.g., "Should a particular forest be preserved or harvested?" (p. 15)) and smaller spatial scales (i.e., stand level) and towards more fundamental questions (e.g., "What kind of forest environment do we want to leave to

future generations?" (p. 15)) and larger spatial scales (i.e., regional or provincial levels).

Step 3: Identify the Alternatives to be Evaluated

Once the decision has been settled on, it directly follows that an appropriate set of alternatives which are defined by the decision context be chosen. The alternatives include all possible action outcomes or options which are to be evaluated within the context of the decision. For example, if the decision facing a decision maker is choosing an appropriate level of preservation, the alternatives would be the various levels of preservation, within a realistic range, to choose from. It is important to use imagination in order to generate as many and as clear a set of relevant alternative options for the decision at hand as possible. This initial list can be paired down later after considering the realism, relevancy, clarity and degree of independence of each and the various constraints which hobble the number of alternatives which can realistically be evaluated in a manageable and cost-effective manner. It is also important to consider at what level each outcome should be evaluated, as outcomes often represent opportunities for further action (Edwards 1977).

If a decision strategy includes more than one action set level, with further actions being prescribed contingent on the outcomes of the initial set, descriptions' of alternatives will need to incIude the simultaneous specification of decision points, events that could take place between them and any information that may be learned along the way. Complicated decision' skategies with dynamic decision processes can be conveniently represented as decision trees (Raiffa 1968; Keeney 1982), with the determination of where to prune (i.e., where to treat an action outcome as an end in itself) a matter of convenience in most cases (Edwards 1977). The level of detail chosen will also depend on the costs and benefits of different levels of analytical detail and corresponding budgetary constraints. Decision trees provide a visual representation of the connections between different acts and events, allowing one to organize the complicated set of outcomes and providing one with the means to see both the complexity of decision situations and the

simplifying assumptions that were adopted to deal with them (Hogarth 1980).

For complex decisions with uncertain, difficult to imagine alternatives, it *may be necessary to develop scenarios, or simplified, hypothetical representations of future events. Such scenarios would be organized around a plausible set of decision outcomes, with each scenario's degree of certainty" of occurrence being represented by expertly determined probabilities (Edwards 1977).*

Step 4: Identify the Relevant Dimensions of Value

Alternatives are normally evaluated on more than one value dimension. An important step in the structuring phase, therefore, is specifying and organizing the different dimensions of value. These dimensions are commonly referred to as objectives and are characterized by the decision context, object and the preferred direction of movement against which alternatives are evaluated (Keeney 1992). For example, for a preservation scenario, one of the fundamental objectives against which the preservation level alternatives could be evaluated is to maximize the spiritual values associated with a wilderness experience. For this objective, the decision context is wilderness preservation, the object is wilderness-derived spirituality and the direction of preference is more rather than less of the value.

Devising a simple list of goals that are deemed important for the decision at hand may help to generate insight into the main objectives (Edwards 1977). Another strategy which is often used to initiate the objective identification process is to specify an ~ unstructured list of possible consequences of the alternatives and organize the generated list into a set of general concerns (Keeney 1982). The process of articulating objectives can be helped along by studying related topics in the literature, conducting analytical studies (for example, by modelling inputs, processes and outputs), and talking to and soliciting ideas from stakeholders, experts and decision makers (Buede 1986).

Keeney (1988) suggests various cues which can stimulate respondents' thinking in

this regard, including pointing out more specific objectives and alternative categories of objectives which have been missed. Also, having them separate objectives which are means to an end from fundamental objectives which are ends in themselves is an important undertaking. Both types of objectives are important to the decision: "Means objectives can be very useful for developing models to analyze decision problems and for creating alternatives. However, it is the fundamental objectives that are essential to guide all the effort in decision situations and in the evaluation of alternatives" (Keeney 1992, 35).

The unstructured list is then normally organized into a value structure of some kind, typically hierarchical in nature. Objective hierarchies are structured in such a way that broad, general objectives are arranged at the top, with specific, detailed objectives that describe aspects of them arranged further down. Although means-ends objectives hierarchies are used in some decision contexts, most decision analysts prefer fundamental objectives hierarchies, where lower order objectives provide detailed descriptions of, rather than means of achieving, higher order objectives (Keeney 1982, 1992). The lowest level objectives require attributes, or performance measures, in order to evaluate the degree of achievement of the objectives (Keeney 1982; McDaniels 1990).

The objective hierarchy or common value tree should represent a complete set of objectives spanning all issues of concern to stakeholders and decision makers and a complete set of attributes providing an adequate basis for assessing the degree to which all objectives are met. The attributes should also be operable; i.e., they should provide a meaningful measure of the objectives in order for the alternatives to be characterized within a realistic evaluation. Other considerations in the structuring exercise include ensuring independence between the preference for and uncertainty surrounding a given attribute (termed "decomposability" by Keeney and Raiffa (1976)) and ensuring that atrnbutes are relatively non-redundant so that double counting does not occur because of overlapping measures. It is also suggested that the atrnbute set be kept to the smallest

size possible while still fulfilling the above suggestions (Keeney and Raiffa 1976 Buede 1986). [43]

Determining the Importance of Dimensions

The goal of this phase is to determine respondents' attitudes toward the relative importance of the various value dimensions by actively eliciting their judgments. This includes having them rank the dimensions in order of importance, translating the rankings to ratings and converting the ratings to numbers that sum to 1.

Step 5: Rank the Dimensions in Order of Importance

This step simply asks respondents to rank order the attributes from the most important to the least important. The ranking task is done by individuals on the basis of their own judgments of the significance of each objective. However, Edwards (1977) recommends that before individuals give separate judgments, the ranking exercise can initially be done within group processes to help foster a common information base.

Steps 6 and 7: Translate the Rankings to Ratings and Normalize

Elicited importance weights are then assigned to the attributes. Weights capture the value judgments of the respondents regarding the relative importance of the rated attributes. Various weighting schemes have been developed for the rating exercise, the most common among them being rank sum weighting, rank reciprocal weighting, ratio weighting and swing weighting.

A rank sum weight is elicited by adopting an inverse ranking strategy: The largest number is assigned to the highest ranked attribute, the next largest number to the atrnbute ranked second, and so on down the ranked list of attributes until the least important attribute is given the weight of 1. The numbers are then added and each number divided by the sum to normalize the number set so they add up to 1.

Rank reciprocal weighting, on the other hand, begins with the assignment of the

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[43] *von Winterfeldt (1980), Buede (1986), Brownlow and Watson (1987) and Keeney (1988) provide detailed descriptions of various structuring strategies.*

numerical value of 1 to the most important attribute, 2 to the next important attribute, and so on down the atrnbute list until the least important attribute is assigned a number which matches its ranked position (i.e., if tenth in the list, it will be assigned a rating of 10). Each numerical value is then reciprocated or divided into 1 and then normalized, thereby ensuring that the most important attribute receives the highest numerical weight.

Because the previous two weighting methods assign numbers to attributes on the basis of their ranks only without considering their relative degrees of importance, many decision analysts prefer procedures like ratio weighting which consider relative worth, despite their being more complicated and time consuming. Ratio weighting begins by assigning the value of 10 to the least important attribute. The attribute that is ranked just above the last ranked attribute is then assigned a number which depicts how much more important it is relative to the least important atrnbute. An assignment of 20 for example would signify that the respondent judges the second least important atrnbute to be twice as important as the least important atrnbute. The respondent then continues up the list until all attributes are assigned importance weights. If two or more attributes are judged to be equal in importance, they are given equal numerical weights. Ratio weighting is complete when each atrnbute's weight is normalized (Edwards and Newman 1982).

Using the concept of importance as a basis for weighting attributes has been criticized by some in the literature (e.g., Keeney and Raiffa 1976). This is because such procedures ignore the dependence of the elicited units of the single attribute on the range of the scale over which the value function is defined. The assigned weights tend to be sensitive to the range of the scale changes, with weights typically increasing with increasing ranges and decreasing with decreasing ranges (von Winterfeldt and Edwards 1986). The relative weights assigned to all the values derived from wilderness, for example, would likely be different if they were elicited within the context of the specified ranges rather than without. For example, the weight spread between ecological values, if

deemed most important, and spiritual values, if judged least important, could be greater if the respondent was asked to consider the gains that would occur in such values as a result of a 6% to 12% level increase in the land base allocated to wilderness than if he were to ignore such a consideration; this outcome would happen if the respondent believes that the preservation doubling enhances the benefits derived from the ecological values more than the benefits gained from the spiritual values, a likely judgment with the former value set being preferred.

Weighting the attributes in the absence of the range in scale thus ignores the differential effects that such ranges have on different attributes. The swing weighting technique is designed to capture such effects by having respondents consider the weight of each attribute on the basis of the differential degree of improvement that occurs in each attribute from a change from the worst alternative (e.g., 6%) to the best alternative (e.g., 12%). von Winterfeldt and Edwards (1986) recommend assigning 100 to the most positively affected attribute, with the others being scaled downwards on the basis of their relative lesser improvements in value. The raw weights are then normalized to add to one as in all the previous weighting procedures.

Measuring Alternatives on the Dimensions

Step 8: Measure the Relative Value of the Alternatives on each Dimension

The next step is to determine the location measure for each attribute. A location measure is an assessment of the desirability of each alternative in terms of the degree to which each contributes to specified improvements in single atrnbutes. Because location measures are expressed as a number technically called an utility, the measure derived from this step is often referred to as a single attribute utility function. Determining the utility function for each atrnbute is complicated by the fact that attributes are not expressed in commensurable units. As a result, resealing is required. The single attribute utility assessment procedure may involve simple mathematical transformations of

objective measures or impressionistic judgments, with the former requiring transformation of what is considered to be true attribute measures into scales with comparable meaning; the alternative latter method is used when the attribute is inherently judgmental, making transformations unnecessary in most cases, as decision makers or impartial experts subjectively derive scales from the onset which allow comparable measures of desirability (Edwards and Newman 1982).

A common means of deriving comparable scales involves using a value or worth scale which goes from O to 100, with the end points corresponding with the minimum and maximum plausible values of the given atrnbute. Experts or decision makers can be helped along in locating each alternative on each attribute's scale by graphically representing the relationship between the natural units of the attribute and its utility units. This is done by having the horizontal or X axis represent the range of an attribute's natural units, going from its lowest to its highest plausible value, and having the vertical or Y axis represent the range of its corresponding utility units, going from O to 100. For linear relationships, a straight line is then drawn from the point of intersection between the O utility measure on the Y axis and lowest plausible value on the X axis to the point of intersection between the 100 utility measure on the Y axis and the highest plausible value on the X axis. Assigning utility is simply accomplished by locating the alternative on the natural scale and reading off its utility on the Y axis. Simple linear relationships between utility scales and an attribute's natural units can also be represented in equational form. As such, if L_A *is the actual location measure for the alternative,* L_{min} *is the attribute's minimum value and* L_{max} *is the attribute's maximum value, the single atrnbute utility for the alternative can be determined with the following equations:*

$$\text{Location of } L_A = 100\ (L_A - L_{min})\ /\ (L_{max} - L_{min}),$$ *where more is preferable to less*

and

$$\text{Location of } L_A = 100\ (L_{max} - L_A)/\ (L_{max} - L_{min}),$$ *where less is preferable to more*

(Edwards and Newman 1982, 66).

Simple mathematical equations can also be developed to measure utilities for bilinear relationships, where an intermediate unit represents the maximum plausible value (see for examples Edwards and Newman 1982, 69). However, locating utilities poses more difficult challenges for respondents who are concerned about the nonlinearity of their preferences. One example of nonlinearity would be when respondents believe that specific attributes follow the economic law of diminishing returns. The shapes of respondents' utility curves also represent their behavior in the presence of risk. One of the simplest ways of overcoming such problems is to ask respondents to draw graphs representing their judgments of the utility curves for each attribute (Edwards 1977). Other direct techniques have also been devised to elicit values for nonlinear preferences, including those dependent on hypothetical indifference judgments, where utility functions are derived by constructing indifference curves for pairs of variables (see MacCrimmon and Siu 1974; Vertinsky and Wong 1975; von Winterfeldt and Edwards 1986). However, these methods are time-consuming, tedious and impractical when tradeoffs need to be made between many variables (Slovic, Fischhoff and Liechtenstein 1977).

Indirect methods, which introduce risk attitudes and probabilities into otherwise riskless situations, have also been developed to assess both weights and utilities. These are justified within MAU theory but are exceedingly complex (see Vertinsky and Wong 1975; Keeney and Raiffa 1976; Slovic, Fischhoff and Liechtenstein 1977). Although difficult to obtain, uncertain y surrounding the magnitude and likelihood of consequences from alternatives can once incorporated, however, be conveniently represented to decision makers; experts can do this by laying out the sequence of connecting impacts with the probabilities of intermediate events using a decision tree or visually showing how decision variables are connected in a causal or sequential manner using influence diagrams[44] (Gregory, Keeney and von Winterfeldt 1992).

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[44] Although the most familiar and widely used structuring tools are hierarchical-based (e.g., decision trees, value trees, etc.), von Winterfeldt (1980), von Winterfeldt and Edwards (1986) and Howard (1988, 1989) explore influence diagrams and other

Step 9: Calculate Overall Utilities for Alternatives

The preceding steps of decomposition and isolation of the relevant attributes are followed by a decomposition step, in which the disaggregated utilities and importance weights are aggregated into a multiattribute utility measure for each alternative. For the SMART description provided, the most frequently used and simplest additive equation[45] *will help illustrate the calculation of the composite utility for each alternative i, summed across the attributes j:*

$$MAU_i = \sum w_j u_{ij}$$

where w_j is the normalized importance weight of the jth attribute and U_{ti} is the resealed utility of the ith alternative on the jth attribute (Edwards 1977; Kozielecki 1981; Edwards and Newman 1982). The w_j measure represents the output of Step 7 and U_{ij} is the output of Step 8. If probabilities are explicitly incorporated into the model, this final utility calculation represents an expected utility (Gregory, Liechtenstein and Slovic forthcoming).

Choice

Step 10: Choose the Alternative

The normative rule is to choose the alternative with the largest assessed utility. Other considerations external to the MAUT model may also be factored into the overall decision and thus influence the final choice; however, the tools and outputs of the model will provide significant guidance to decision makers in their determination of the best overall alternative. Also, modifications to the procedures outlined above will allow other conrnbutory factors, such as budgetary constraints, to be integrated into the model (Edwards 1977; Hogarth 1980).

For SMART or other versions of MAUT to be used with confidence, the

alternative decision organizers.

45 See Keeney and Raiffa (1976) and von Winterfeldt and Edwards (1986) for examples of multiplicative and other MAU aggregation rules.

assumption of value independence should be checked. Value independence means that preferences for any dimension ofa specific alternative should not be affected by its measurements on the other dimensions; in other words, there must not be strong interactions between attributes interrnsof therespondent's preferences (Hogarth 1980).

Also, sensitivity analysis can help boost confidence in the evaluative results if such an analysis uncovers very little variability between them. This is done by observing the extent to which overall preferences for alternatives change when quantitative inputs (e.g., weighting schemes, outcome probabilities, etc.) to the problem are varied (Hogarth 1980). Sensitivity analyses can detect those inputs which have inordinate influences on the total utility measure and should, as a result, be subject to additional elicitation from stakeholders or the public at large. They can also help analysts identify and begin to diminish the major causes of disagreements between stakeholder groups over differences in utilities and weights (tradeoffs) by targeting those input variables which consistently bring preference measures into greater quantitative agreement and revealing to stakeholder groups how small alterations in their utilities and tradeoffs can result in significant changes toward the calculated values of other groups (Gregory, Liechtenstein and Slovic forthcoming).

It is also important to note that not all of the steps outlined above need to be covered or slavishly followed as sequentially presented in order to act as an analytical tool for addressing complex decisions (Hogarth 1980). For example, the structuring phase may explicitly clarify and organize stakeholders' preferences in such a way that areas of conflict are clearly identified, making resolution through a negotiated compromise possible. The latter stages may also be ignored if an obvious option comes to light which all involved discern as mutually advantageous.

Applications

MAUT within the normative framework of decision analysis has been used to

evaluate complex decisions in a diverse variety of public and private contexts, including in the corporate, health and safety, social, educational, energy, environmental, developmental planning and resource management fields. [46] *In terms of environment-related issues, decision analyses have been used as a decision aid for the siting for disposal (Merkhofer and Keeney 1987), transporting (Keeney 1988) and management (Lathrop and Watson 1982) of nuclear waste, the siting of energy facilities (Keeney 1980), the setting of long term energy policies (Keeney, von Winterfeldt and Eppel 1990), the setting of environmental standards (North and Merkhofer 1976; von Winterfeldt 1980, 1982) the constructing of objectives for climate change research (Keeney 1992) and the selecting of alternative development options which have environmental consequences (Keeney and Wood 1977; Rozelle 1982; Edwards and von Winterfeldt 1987).*

Despite being employed for such forestry problems as fire and pest protection (Helling 1978; Cohan, Haas and Roussopoulos 1983) and silvicultural prescription selection (Marten and Fullerton 1987; Brumelle et al. 1988; Pearce, McDaniels and Swoveland 1990), McDaniels (1990) points out that decision analysis has rarely if ever been used for land allocation decisions. Drawing on the literature, as well as a case study in which he interviewed four stakeholder representatives for the purposes of eliciting and structuring objectives which are relevant for old-growth forest decisions, McDaniels (1990) concludes that there is significant scope for the use of the techniques of decision analysis in clarifying decisions related to forest allocation. He goes onto say (p. 51) that "This clarity can come in a better representation and understanding of the value conflicts involved, a better representation of the implications of alternatives, and the creative design of new alternatives that are seen as more attractive by all parties", and recommends the sponsoring of selected case studies in order to determine the potential uses of decision analysis for old-growth forestry decisions.[47]

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[46] *See Keeney and Raiffa (1976), Keeney (1982) and von Winterfeldt and Edwards (1986) for examples of experimental and real applications of decision analysis and MAUT.*

[47] *Decision analysis has also been recommended as a decision tool for managing*

Strengths

The primary strength of MAUT is that it conforms to the constructive nature of human preferences by openly encouraging participants to successively revise and refine their values while learning as they go arid by accommodating the multidimensionality of such values (Gregory and McDaniels 1987). By decomposing multifaceted, complex decision problems into systematic, explicitly specified and simpler substeps, MAUT eases the cognitive task of making judgments in the presence of complexity (Eils and John 1980; Gregory, Liechtenstein and Slovic forthcoming).

Value formation and clarification is facilitated by the use of such structuring aids as value trees and objective hierarchies. The process of developing a mutual set of structured objectives such as a common value tree, along with various cues to spur thinking about values, helps respondents uncover, clarify and organize important and sometimes hidden values and attributes, as well as identify irrelevant ones (Brownlow and Watson 1987). New ideas which form out of the process of deriving a clear set of objectives feed back to the option generation step, encouraging the creation of additional alternatives or exposing formerly conceived ones which should be improved or rejected. A complete and clear set of objectives also provides a guide for data collection and scenario selection; this supports the task of obtaining data that help evaluate the relative desirabilities of the consequences from various alternatives on the objectives and different scenarios which could improve such an evaluation (Edwards and von Winterfeldt 1987; Keeney 1988, 1992).

Explicit elicitation of values and attributes, as well as the combined effort of structuring and refining generated objectives, should facilitate communication and mutual understanding between stakeholders and highlight areas of common interest and disagreement, thus providing a basis for resolving conflicts and making tradeoffs through

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endangered species (see Maquire 1991).

compromise (Keeney and Raiffa 1976; Einhom and McCoach 1977; Keeney 1988, 1992). Moreover, the mechanical, systematic nature of the process allows interviewers to teach the framework and its steps with relative ease, making it relatively transparent (i.e., readily understood) (Einhom and McCoach 1977; Howard 1988). It is also suggested that simply providing a more systematic structure within which preferences and values can be openly aired helps reduce disagreement among members in group processes (Eils and John 1980).

MAUT, besides encouraging explicit valuation judgments from respondents, also promotes explicit factual judgments from experts. Experts are allowed to concentrate on the activities that they are familiar with, such as assessing risks and judging probabilities, while stakeholders are allowed to concentrate on constructing the dimensions of value. Because the method provides a logical and systematic means of distinguishing facts from values, subjective, intuitive knowledge and objective data can be deeply examined and developed by each group and then later combined. This eases the task of each group and relatedly improves the quality of the information obtained (Keeney 1982; Gregory, Liechtenstein and Slovic forthcoming). It also helps to differentiate between disagreements based on values and those based on facts (Maquire 1991).

Because tradeoff issues form an inherent part of decision problems, they must be addressed either explicitly or implicitly in the overall value model. By explicitly assessing value tradeoffs among atrnbutes through their ranking and weighting and option tradeoffs through their relative utility measures, MAUT handles the issue in the preferred definitive and open manner. It forces stakeholders to make informed tradeoffs between objectives. Moreover, explicitly and clearly structured objectives and atrnbutes help inform the rating exercise (Gregory, Keeney and von Winterfeldt 1992).

Additional strengths of MAUT include its flexibility, agility in integrating market and non-market values, lessening of the embedding problem and lessening of problems deriving from people's beliefs about non-independence (Gregory, Liechtenstein and Slovic

forthcoming). Firstly, MAUT is flexible in changing circumstances. Having explicit and methodical stages in which to elicit value attributes and utilities permit researchers to redo calculations when additional new information arises.

Secondly, neither market values nor non-market values are given an advantage in the MAUT model. Both economic models and simple non-market measures can be accommodated.

Thirdly, because respondents are assisted in structuring their monetary values in a defensible manner, people's representation of such values are improved, thus reducing the embedding problem. If, on the other hand, the source of the problem arises horn people's desire to "purchase moral satisfaction" (Kahneman and Knetsch 1992), embedding will also be lessened, as MAUT does not focus directly on the spending of money. MAUT would also help to reduce the cause of embedding that arises from people's inabilities to respond with sufficient refinement to design specifications (Gregory, Liechtenstein and Slovic forthcoming), or other complexity-inducing problems which diminish people's abilities to absorb details (see Fischhoff et al. 1993), because its elicitation methods are decompositional, thus allowing people to evaluate various dimensions of value sequentially as opposed to cognitively handling them all at the same time. Also, the utility for each attribute is elicited across the range (e.g., respondents could be asked to give swing weights for the various wilderness values when going from 6~0 to 12~0 or asked to give separate weights for each value at both levels).

Lastly, holistic approaches such as the CVM are susceptible to eliciting measures of values from people which are biased because of people's perceptions of value dependencies; this occurs when an improvement in one value is thought to lead to an inevitable, similar improvement in another related value. Such beliefs about non-independence would be uncovered in MAUT's structuring phase, enabling the model to accommodate them through adjustments.

Guntonand Vertinsky (1990, 9)provide inappropriate concluding assessment of the strengths of decision analysis in which MAUT is embedded in the following paragraph:

> *The advantage of decision analysis is that it allows flexibility in terms of objectives, definition and measurement of effectiveness. It allows an expression of subjective preferences among timings of consequences and the degree of uncertainty which is involved. The technique is transparent, the assumptions are minimal, and data bases can be used in conjunction with judgment to ensure comprehensiveness. The technique encourages a systematic approach to problem solving and provides a framework for sensitivity analysis.*

Weaknesses

Although it is thought that some of the cognitive biases outlined earlier within the CVM section will be reduced using a well designed and applied MAUT process, it is not known whether the confidence in these potential improvements is well founded, nor whether such improvements are significant. Also, MAUT can theoretically suffer from the same motivational biases which afflict CVM, although, with the problem being decomposed down to greater levels of structured detail and with monetary measures being relied on less, hypothetical biases may be lessened. Again, motivational biases will present less of a problem if the interviewer possesses strong analytical and interactive, skills and the process is well structured from the onset. As with the CVM, the type and detail of information provided and other contextual influences may introduce bias. However, again as with the CVM, the significance of information bias is not known and may be mitigated against. In any event, MAUT, by being a more detailed and structurally refined assessment approach, presumably possesses sufficient structural latitude to accommodate constructed scenarios with greater degrees of plausibility and realism, thereby retaining the capacity to reduce information and other biases and errors more successfully than the CVM.

The high costs of time and money involved in preparing for, conducting and

analyzing the results from a detailed MAUT workshop is often cited as a major disadvantage of the approach (Keeney, von Winterfeldt and Eppel 1990). Others have argued vat the additional information provided may justify the added cost (Einhom 1974) and that simpler, less costly MAUT procedures can be designed to reduce the time and expense involved while still generating useful results (Einhorn and McCoach 1977; Edwards and Newman 1982). Gregory, Liechtenstein and Slovic (forthcoming) add that the cost of CV processes may be increasing due to such recent trends as using focus groups and avoiding mail-based surveys, resulting in a reduction in the disparity between the costs associated with doing MAUT and CV assessments.

Another criticism levelled against MAUT is the relatively high degree of expertise required of the analyst, with the assessment necessitating the full participation of the analyst throughout the elicitation procedure and the application of the MAUT techniques involving as much art as science. Gregory, MacGregor and Liechtenstein (1992) and Gregory, Liechtenstein and Slovic (forthcoming) counter that the skills required are no more demanding or subjective than conventional CV or benefit-cost analyses. Howard (1980, 1988) adds that use of such structuring tools as influence diagrams eases the demands on both the analyst and respondent.

Other concerns have centered on problems which can arise when applying the various aspects of the steps involved in decision analysis. Vari and Vecsenyi (1983) and von Winterfeldt (1983) provide examples of many of these as well as various strategies to minimize their effects. von Winterfeldt (1983), for example, identifies difficulties which can occur as a result of hidden agendas in the client-analyst relationship, poor definition of the decision problem, numerous institutional obstacles, structuring and elicitation complexities and obstructions in using and implementing the model. He adds that such problems can be reduced through improved and more insightful preparation, design and execution of the analysis (in the case of design problems) and through improved

understanding, interaction and levels of trust between the players (in the case of motivational problems). Many of these have been alluded to earlier in the procedural outline of MAUT.

Although convergent validity studies have found high correlations among a variety of models (risky and riskless, multiplicative and additive) and assessment methods (holistic and decomposed) it is not known how valid MAUT's results are. Finding agreement between the elicited values of MAUT and CVM (see, for example, Humphreys and Humphreys 1975), for example, reveals nothing about the validity of MAUT when the validity of CVM is unknown (Slovic, Fischhoff and Liechtenstein 1977; Kozielecki 1981). Validating MAUT techniques by comparing alternative MAUT models, on the other hand, has shown that decomposition procedures are more valid than holistic approaches in some circumstances (see, for examples, Fischer 1976, 1977); how generalizable these results are are unknown at this point however.

4.0 CONCLUSIONS

Various valuation techniques have been devised to provide measures for non-market goods and services so that they, along with market benefits, can be represented in decisions, including those involving land allocation. The travel cost method (TCM) and hedonic price method (HPM) have been advanced as two indirect techniques which can elicit some wilderness values. Both attempt to address the valuation problem by observing the revealed preferences of consumers in markets with related commodities, with travel costs being used as surrogate prices for recreation values within the TCM and hedonic prices being used as surrogate prices for extra-market attributes within the HPM. Although they each have strengths which allow them to address different facets of the valuation problem, serious shortcomings limit their use in valuing wilderness commodities, the most serious one being ~ their inability to handle the non-use values

ascribed to wilderness.

Various alternative valuation approaches have been promoted to correct for this omission and other problems and stringent assumptions arising from revealed preference-based methods. Directly eliciting values from individuals and groups with a stake in a decision is an example of this, and includes the contingent valuation method (CVM), which relies heavily on holistic judgments, and multiattribute utility technology (MAUT), which is based on the decomposition strategy. Though it cannot be stated with certainty that MAUT represents an improvement over holistic approaches, recent evidence coming from empirical studies and out of the psychological literature provide impetus to the notion that it is a superior approach in eliciting complex values in complex decis+on contexts. MAUT is a technique that appears to be in greater harmony with such cognitive strategies as those related to simplifying heuristics and preference construction. MAUT helps participants to identify and organize the various dimensions of their values and then uses these as a means for weighing value tradeoffs. Holistic WIT or WTA measures like those coming from most CV studies, on the other hand, ignore such cognitive realities and thus may place too many cognitive demands on the people engaged in complex elicitation tasks (Gregory, Liechtenstein and Slovic forthcoming).

As a result, MAUT may be a more valid technique than approaches based on willingness to pay (e.g., CVM) and surrogate prices (e.g., TCM and HPM) in decision environments that include incommensurable, complex and uncertain amenity resource values.

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